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This issue's cover illustrates our theme of contracting for naval facilities.

NAVY CIVIL **Engineer**

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Summer 1990	Seabees	April 15, 1990	July 1-15, 1990

Inter-service cooperation provides better training for reservists

By JOCS DONNA L. WIELINSKI, USNR
Reserve Naval Construction Force
Lenexa, Kan.

Using limited resources, how can a reserve unit provide its members with useful and effective training?

Reserve Naval Mobile Construction Battalion TWENTY-FIVE's (RNMCB-25's) St. Paul, Minn.-based Detachment 0425 came up with a creative solution: find others who have the same problem, share resources, and by working together, increase the effectiveness of everyone's training program.

Seabee Detachment 0425 has been putting its solution to work for almost a year, and in early fall undertook its most ambitious training project, a field exercise named "TRI-OPS (for Tri-service Operation) '88," a field exercise involving Army, Marine Corps, and Navy reservists from 10 different commands.

According to its planners, TRI-OPS '88 is proof that reserve units from different services can work and train together.

Construction Electrician Second Class Petty Officer Bill Kidder, the Detachment's training petty officer, made the initial contact with other reservists and began putting together the exercise early in 1988. "I knew there were other military units in our area in the same training boat," explained Kidder, "and I wanted to put together a local training support network between the services."

"It started out small," remarked Kidder. "I contacted Master Sergeant Bob Freiermuth at the 5042nd Army Leadership School about instructors for a land navigation class, and one contact led to another," Kidder added.

As the network of contacts between the services grew, so did the idea of a joint-service field exercise.

"We found that having different mobilization missions wasn't necessarily a bar to working together," commented Kidder, "and we were able to put together an exercise scenario in which each command played an important part related to their own particular training needs."

During planning meetings in the months before the actual exercise the services planned what each would do.

Naval Reserve medical personnel from Fleet Hospital Detachment N CBTZ 250 wanted training in triage and emergency medical care. Their part would set up a field medical unit for triage and provide medical support.

Seabee Detachment 0425 needed actual operational field experience and would form patrols and set up a defensive perimeter.

Army reservists from the 3rd Battalion/3rd Infantry had just finished an advanced field infantry course and wanted to sharpen what they had learned; they volunteered to form an aggressor force. They would also provide weapons for the Seabees.

The 5042nd Army Leadership School and the 88th Army Reserve Command would furnish instructors for training classes prior to the actual exercise and provide evaluators in the field.

Marines from the Headquarters Battalion of the 4th Marine Division and Marine Support Group 47 Detachment A would provide chemical warfare, communications, and weapons training before the exercise and act as observers.

The Minnesota National Guard would provide transport for the Fleet Hospital Unit, and Company D, 147th Aviation 3rd Combat Helicopter Platoon, Minnesota Air National Guard would furnish seven helicopters to airlift the Seabees 30 miles to the exercise site at the University of Minnesota Research Center at Rosemount, Minn.

Naval Reserve Readiness Command Region 16 would arrange for stretchers and stretcher stands for the Fleet Hospital Unit and Seabee Detachment 0425's parent battalion RNMCB-25 would arrange for 782 gear, gas masks, and radios to be shipped from the battalion's

Seabee perimeter guard BU2 Patrick Rude of RNMCB-25's St. Paul, Minn.-based Detachment 0425 watches aggressor forces.

readiness support site 400 miles away at Glenview, Ill.

To a large extent, the exercise scenario worked.

Fifty-six Seabees from Detachment 0425 airlifted by helicopter to the exercise site. Arriving by bus, Fleet Hospital personnel set up medical facilities in the area.

It was the Seabees' job to set up a command post and security perimeter. Upon landing, Seabee patrols moved through fields and heavily wooded areas. As each patrol moved from the landing zone toward their designated areas they were "attacked" by aggressors from the 3rd Battalion/3rd Infantry Army reservists who had gone into the area the previous day to reconnoiter and stayed overnight. Each patron also had to avoid booby traps set by the Army reservists and undergo hit-and-run attacks which included CS "tear" gas and smoke flares.

Master Sergeant Peter Daut, 5042nd Army Leadership School, found the Seabee's quick response to the CS gas and smoke attacks during the exercise particularly noteworthy. "I'm impressed," he commented. "I know some infantry units that don't react that fast in putting on their masks," he added.

According to the Seabees, their fast reaction to CS gas attack was due to the chemical warfare training they received in June from Marine Sergeants Tim Gordon and Alan Voracek of Marine Support Group 47.

They were also grateful for a land navigation class in April and field compass course in May designed especially for them by Specialist First Class Dianne Kreiger, 5042nd Army Leadership School. "Without her compass course, we probably wouldn't have gotten from the helicopter landing zone to where we needed to be as quickly as we did," commented Builder Second Class Petty Officer Patrick Rude of the Seabee Detachment.

Communication is critical to any field operation, and with the help of Sergeant Shawn Scanlon of the 4th Marine Division's Headquarters Battalion Military Police Company's practical instruction in PRC 77 radio procedures in June, all ground units were able to keep in touch with each other.

TRI-OPS '88 proved to be a learning experience for everyone involved.

"Each time we do these kinds of things, we're learning, and that's the name of the game," remarked Command Sergeant Major Donald Kronberg, 88th Army Reserve Command.

Seabee patrol leader BU1 Wilfred Osborne heads through a tear gas cloud during an aggressor force attack.

Exercise evaluator Army First Sergeant James Hovda, 3rd Battalion/ 3rd Infantry, takes notes as he observes Seabees during TRI-OPS '88.

"Even when things don't go just as we planned, we learn something, added Lt. Dick Fischer, RNMCB-25 assistant training officer. "Learning how to do something just isn't enough . . . you have to actually do what you learn in the classroom," remarked Lt. Fischer. "Which is why we need field exercises . . . not only to practice what we learn, but to learn what can go wrong in the field."

In this case, what went wrong was communication between the Seabees on the ground and the medical evacuation (MEDIVAC) helicopter.

"Because we couldn't airlift 'wounded' Seabees to the Field Hospital's location for 'treatment,' our people did not get as much work as they might like," commented Cdr. Robert Beck, senior medical officer and Fleet Hospital observer. "On the other hand, the hospital corpsmen on patrol with the Seabees learned how to cope with wounded when you can't airlift them out."

"Mobilization readiness is the first priority for any reserve unit," remarked Cdr. Tom Watry, Seabee Detachment 0425's officer in charge. "Working together on TRI-OPS '88, we learned that different services can share resources to build a training program which is not only interesting and effective, but also makes a positive contribution toward everyone's mobilization readiness." □

USING ADMIXTURES IN CONCRETE

What are the advantages?

By LT STEPHEN T. ECKEL, CEC, USN
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Director
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In an article I wrote for the summer 1988 issue of the *Navy Civil Engineer*, I suggested that the use of mineral admixtures and/or pozzolans in concrete might improve its long-term strength and durability. I'd like to elaborate on how this phenomenon occurs in concrete and review the available materials and their advantages.

Mineral admixtures may or may not have cementing properties when placed in a concrete mix. This discussion is limited to pozzolanic admixtures. Before properties and types of pozzolans are discussed, one should be comfortable with the definition of a pozzolan. The dictionary says that a pozzolan is "any variety of natural and artificial substances added to cement to lend particular properties." For our use, a pozzolan will be defined as a material which has little or no cementing properties, but when finely ground it combines with calcium hydroxide in the presence of moisture to form compounds with cementing properties.

This pozzolanic reaction has the following features: (1) it is a slow reaction, which means that it develops strength and releases heat slowly; (2) lime is consumed rather than produced; (3) it is energy efficient in that it uses less cement and consumes materials which are a byproduct of other processes, reducing the environmental impact of their disposal; and (4) the large capillary spaces of concretes with pozzolans added are filled, improving impermeability and strength of the concrete.

Before discussing the various admixtures and pozzolans, the above features must be explained. Shrinkage and thermal cracking, caused by the change in volume of concrete as it cools, is a serious problem in the placement of concrete. If cracking is not controlled, the concrete's ability to resist water infiltration is significantly reduced. Some crack control can be achieved by controlling the rate of cooling. However, the easiest solution is to control the temperature rise of the concrete, automatically easing the problem of temperature fall. As mineral admixtures replace cement, heat of hydration is reduced due to the lesser quantity of cement to be hydrated. The admixture may also combine in the long term with lime to increase strength.

As the pozzolanic reaction consumes lime, it not only provides strength (a calcium-silicate-hydrate compound is much stronger than lime), but reduces the alkalinity of the concrete and improves its resistance to sulfate and acidic environments. An additional positive byproduct of this reaction is that the compounds formed of the admixture, lime and water are much finer, reducing the pore sizes and the spaces around the large aggregate. This makes the concrete less permeable and eases the transfer of load from the hydrated cement paste (HCP) surrounding the aggregate to the large (coarse) aggregate. This strengthened zone around the large aggregate is sometimes called the transition zone (TZ) and is crucial to the strength and durability of concrete.

Admixtures or pozzolans may either be added to the cement or to the concrete mix. Two types of cements are available with the admixture blended: types IP and IS. Type IP is a blend of portland cement (type 1) with a fine pozzolan, where the pozzolan is 15 to 40 percent of the weight of the total cement. Type IS cement is a blend of portland cement and fine granulated blast-furnace slag, where the slag is 25 to 70 percent of the weight of the IS cement. It should be understood that the mineral admixture or pozzolan replaces cement. The mix design must take into consideration this loss of initial strength due to the lower cement content.

Other types of materials used as pozzolans are fly ash (a fine ash produced from the combustion of powdered coal in power plants), condensed silica fume (a product of induction arc furnaces in the silicon metal and ferro-silicon alloy industries) and rice husk ash.

A summary of the advantages to the use of pozzolans follows:

- Durability to chemical attacks is improved due to pore refinement and reduction of alkalinity;
- Heat of hydration is lowered, improving durability to thermal and shrinkage cracking;
- Workability improves, due to the fineness of pozzolans; and
- Energy and economy--less cement requires less energy and using byproduct pozzolans in concrete eliminates the problem of disposing of them elsewhere. □

How can we improve our public works support?

By ALVIN J. FIRST
Claimant Support Section
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Philadelphia, Penn.

Today, the Navy provides public works support by one of three methods: public works centers (PWCs), public works departments (PWDs), or public works lead activities (PWLAs). Of these methods, the PWDs and PWLAs have experienced problems which actually may have hindered their maintenance management programs.

The Public Works Department

The PWD is the self-contained department within the activity with the responsibility for all public works functions. It performs all PW management functions as well as the shop functions such as maintenance, utilities, and transportation. Depending on the size of the activity, both the quantity and quality of the management staff can vary. PWDs generally have minimal staffs and lower graded positions performing the same type of work that is done at larger activities or PWLAs by higher graded personnel. Because they cannot support higher grade levels, recruitment and personnel retention is a problem. Consequently, they are unable to develop management expertise to properly manage department resources.

The Northern Division's (NORTHDIV's) of the Naval Facilities Engineering Command (NAVFAC) experiences indicate that invariably all PWDs experience the same or similar problems. However, because they are autonomous and there is little dialogue among the PWDs, each PWD resolves its problem independently of other PWDs. This results in a duplication of effort and an overall increase in the total number of overhead personnel at PWDs.

The biggest problem facing the PWDs is budgetary. Most PWDs have sufficient workload to support their work force. However, because they are an overhead function, whenever the activity takes a budget cut invariably the PWD is told to absorb all or at least some of the reduction while maintaining the same level of work. In many cases, it's a "no-win" situation.

The Public Works Lead Activity

Some of the problems experienced by the PWDs are addressed by the PWLA. The concept of the PWLA was originally established by OPNAVINST 11010.30 in 1970. Under it, a PWD at a major activity is not only responsible for providing PW functions to its parent activity, but also to smaller adjacent activities, usually on the same base, under the terms of an intra-/inter-service support agreement.

While the PWLA eliminates much of the duplication of effort discussed above, it creates another problem which runs counter to a basic principle of organizational management--you cannot serve two masters. In actuality, that is what is happening under the PWLA concept. Not only do public works officers (PWOs) of the lead activity report to the commanding officer of the activity to which they are assigned, but they must also serve the commanding officers of the activities they are supporting.

Given the situation that PWOs of PWLAs must set priorities for their workload between those of their parent activity and the other activities they are servicing, it can be expected that the workload of the parent activity would get top priority. This could and does influence the timeliness of PW support to the other serviced activities; timeliness is the biggest complaint of serviced activities of PWLAs.

Another facet to be considered is NAVFAC's involvement. As the Navy's engineering arm, its role is advisory. As the Navy's contracting arm, the PWOs report directly to the Commander of the Naval Facilities Engineering Command as officers in charge (OICs), receiving their contracting authority through the Commander. So the PWO of a PWLA is now required to report to a third master.

Alternatives

A proposed alternative to these two methods is to no longer have PWDs at the activities. PWCs, reporting directly and solely to NAVFAC, with the mission of providing PW support, should be established. Utilizing the zone company concept, the PWC would perform all public works functions for all activities within their geographic area. Activities would be serviced under the zone company concept.

The zone company concept was developed at several PWCs in an effort to improve response to customer needs. Zone companies are assigned to specific buildings, facilities, or geographic areas and are responsible for all work performed there. This includes service calls, PMs, standard jobs, minors, and specifics. Where implemented, it has proven successful. As an example, the headquarters of the

PWC for the Philadelphia area would be located at the Philadelphia Naval Base where all management and overall planning would be done. Zone companies would be established at and be responsible for all PW functions at each of the following geographic locations: the Philadelphia Naval Base; the Naval Air Development Center, Warminster, Penn.; Naval Air Station, Willow Grove, Penn.; Aviation Support officer, Philadelphia, Penn.; Naval Air Propulsion Center, Trenton, N.J.; Ships Parts Control Center, Mechanicsburg, Penn.

Having the PWCs solely responsible for maintenance management eliminates the PWOs having dual responsibility. NAVFAC would have sole responsibility, with each activity being treated equally.

In addition to the organizational advantages, there are also procedural and budgetary advantages. The full scope of work performed by the PWCs allows for the training and development of better qualified management personnel. The size of the PWCs allows for economies in purchasing of material, better utilization of equipment and management systems, and a reduction in overhead personnel.

Budgetwise, having PWCs responsible for providing PW services removes the PW function from having to absorb activity ceiling reductions. Also, the price an activity pays for facility maintenance becomes more of a fixed cost similar to that of contract performance.

Finally, having only PWCs establishes a single point of responsibility within the Navy for all phases of facility maintenance management--NAVFAC.

The success the PWCs have enjoyed with the commercial activity studies only serves to support their further use throughout the shore establishment. □

Reserve Seabees support NCEL

By ENS BRADLEY POSADAS
Assistant Alfa Company Commander
Reserve Naval Mobile
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Photos by PAUL DEL SIGNORE
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Port Hueneme, Calif

Recently 18 reserve Seabees from Reserve Naval Mobile Construction Battalion SEVENTEEN (RNMCB-17), commanded by Capt. (Sel.) Clifford H. Royal, assisted in removing and storing two prototype tension membrane structures located on Naval Civil Engineering Laboratory (NCEL) property at Port Hueneme, Calif.

This provided a unique training opportunity for a mobile construction battalion since the Navy and Marine Corps are introducing tension membrane structures into the fleet for expeditionary and advanced base applications. Concurrently, the exercise provided NCEL a clear site for new construction.

A tension membrane structure is a frame-supported, fabric-covered shelter. The biggest advantage this structure has is that it can be erected quickly on almost any surface, such as bare ground, sand, asphalt, concrete, or AM2 matting. It immediately provides an on-site facility for troops to use and can provide protection from the weather elements to materials or equipment normally stored outside. Depending on the size of structure and favorable weather conditions, it can be erected or disassembled by minimum crew size of six persons in approximately 20 hours. The two NCEL prototype structures are very similar to the Marine Corps' prepositioned hangers, the Naval Air System Command's maintenance shelters, and the Marine Corps' medium-size maintenance shelters.

In his letter of appreciation to RNMCB-17, Commanding Officer of NCEL Capt. Donald R. Wells, CEC, USN, remarked, "The Seabee 'can do' spirit of your personnel was very evident and your men did an excellent job on short notice . . . their high standard of teamwork and professionalism prevailed."

Those reservists who participated were: BU1 Bader (petty officer in charge), UT3 Boyle, SW3 Garnica, CE2 Hancock (safety), SN Hands, CE2 Hustad, BUCN Jacobson, SW2 Kinkead, EO1 Litzsinger, BUCN McCoy, BUCN Montani, BUCR Pendelton, Ens. Posadas (officer in charge), UTCN Quezada, UT2 Reveles, UT2 Smith, CECN Tillman, and SW3 Weir.

RNMCB-17 is currently comprised os approximately 700 reservist and 5 active duty personnel. This "desert" battalion is made up of 10 detachments having personnel geographically located from Southern California, Nevada, and Arizona. □

EO1 Litszinger of RNMCB-17 uses forklift to slowly lower frame on tension membrane structure.

There's a new Seabee presence in the South Pacific . . .

By LCDR GARY A. ENGLE, CEC, USN
P.E., Ohio
Officer in Charge, Seabee Camps Pacific
Commander, Naval Construction Battalions
U.S. Pacific Fleet
Pearl Harbor, Hawaii

When fighting in the South Pacific came to a close in 1945, U.S. Navy Seabee presence in the South Pacific also ended. Seabee visibility in these island nations has been limited primarily to 13-man civic action teams (CATs) deployed to the Federated States of Micronesia and the Republic of Palau.

Within the past three years, however, the U.S. Pacific Command's peacetime strategy has changed that. Pacific Fleet Seabees are visiting many remote, diverse South Pacific island nations and territories to complete construction project associated with humanitarian and civic action training exercises.

Designed to strengthen alliances, enhance military preparedness, expand U.S. influence, and aid--as appropriate--in nation building and growth, this peacetime strategy is producing tremendous benefits for countries throughout the region and for the United States and its Seabees.

By our carefully employing resources, skillfully tailored to meet the specific needs of each nation, we provide positive examples of our interest and concern for the welfare of Pacific islanders. In addition, the Naval Construction Force (NCF) Seabees gain valuable training and experience, from predeployment assessment and planning stages through construction completion and post-deployment reports, the type of detailed training which has valid wartime application. The availability of such training opportunities is a prerequisite to Seabee involvement in any humanitarian, disaster relief, or civic action program in the South Pacific.

Ten such exercises have been completed within the past three years and are categorized into three major types: disaster recovery, ship representational cruises, and special civic action missions. Figure 1 summarizes Seabee involvement in South Pacific since the first exercise in April 1986. The steps required in planning and executing each of these missions are much the same.

PACIFIC NAVAL CONSTRUCTION FORCE SEABEE PEACETIME STRATEGY PARTICIPATION

Exercise	Type	Dates	Locations	Battalion	Team Size
USS Badger Cruise	Ship Cruise	Apr-May 1986	American and Western Samoa, Tonga, and Tuvalu	NMCB-4	14 men
Kennel Sun 86-1	Disaster Recovery	Sep-Dec 1986	Guadalcanal and Malaita, Solomon Islands	NMCB-3	94 men
Western Samoa	Civic Action	Sep 1986	Apia, Western Samoa	NMCB-40	14 men
Typhoon Orchid Recovery	Disaster Recovery	Jan 1987 Jun-Oct 1987	Fais Island and Ulithi Atoll	CATs 0327 and 0117	11 men
USS Florikan Cruise	Ship Cruise	Jun-Aug 1987	Cebu, Yap, New Guinea, Guadalcanal, Kwajalein, Tarawa, Christmas Islands	NMCB-7	6 men
Bearing Tiger 88-1	Special Operations	Nov 1987-Jan 1988	Corregidor, Philippines	NMCB-74	22 men
Bearing Sun 88-1	Disaster Recovery	Dec 1987-Feb 1988	Port Vila, Vanuatu	NMCB-62	24 men
USS Barbour County	Ship Cruise	Jan-Feb 1988	Tonga, American and Western Samoa	NMCB-133	24 men
USS Conserver	Ship Cruise	Mar 1988	Western Samoa, Tarawa, Majuro, Eyebye	CBU-413	7 men
USS Brewton	Ship Cruise	Jun-Aug 1988	American and Western Samoa, Vava'u and Nuku'Alofa, Tonga, Townsville, Australia, Rabaul, Lae, and Port Moresby, Papau, New Guinea	NMCB-7	12 men
Bangladesh Floods	Disaster Assessment	Sep 1988	Dhaka, Bangladesh	CBPAC participation in OFDA disaster assess.	
Thailand Floods	Disaster Assessment	Jan 1989	Southern Thailand	CBPAC heading a tri-service assessment team	

Figure 1

DISASTER RECOVERY

Once proper authority receives word that a South Pacific nation has been hit by a major natural disaster such as a typhoon, cyclone, or flood, and it is determined that legal authority exists to provide assistance, an assessment visit is made to the island to survey damage and the country's geography and to determine the capability for a Seabee training exercise. This trip is normally within five to seven days after the incident, and the Commander, Naval Construction Battalions, Pacific (COMCBPAC) assessors look for construction projects which have wide community impact and can enhance the operational readiness skills of the Seabees. Schools, roads, hospital clinics, timber bridges, and waterlines are the types of projects that fit both needs.

Commitments to provide assistance are not made during the visit. Specific projects and support requirements are identified, possible funding sources are analyzed, status of forces agreements are discussed with embassy representatives, slides of construction sites and damaged buildings and areas are taken, logistics support availability for air and ship transport is researched, and local contacts are made. In short, a detailed exercise scenario is developed and briefings, along with proposals, are prepared for senior flag officers.

COMCBPAC assessors look for construction projects which have wide community impact and can enhance the operational readiness skills of the Seabees.

Each briefing includes a plan which combines needed disaster recovery with beneficial Seabee training. Many factors enter into a decision to give humanitarian assistance: project material funding, military transport availability, political ramifications, and economic feasibility of executing the exercise. The plan needs to tie workload to local and military resources and show how the deploying unit will subsist in the environment and perform the tasking in the time allotted.

Department of Defense funding cannot be used for procurement of the construction material. However, funding for such material often has been provided by the U.S. Agency for International Development (USAID) office that has jurisdiction in the area. Projects also can be locally funded by official or private sources.

Throughout the exercises of the past three years, we have developed, improved, and refined checklists to help track the details during the planning stages. Involvement in each exercise has provided excellent experience for Sea-bee officers and men. Interfacing with ambassadors and high-ranking island officials is common, as are briefings to flag officers who assess the feasibility and timing of any proposed military effort.

Once a scenario is approved as a beneficial training exercise, a Seabee unit is selected, tasked, and coordination begins. A predeployment trip is normally conducted with the officer in charge of the deploying unit, and a detailed construction planning package is put together for the tasking. This trip generally is 7 to 14 days after the assessment visit, but sometimes can be combined with the assessment trip, depending on the scopes of work and the specific exercise circumstances.

The assessment visit provided basic information and established local contacts. The predeployment team develops firm cost estimates, material takeoffs, local construction material price listings, and equipment and tool requirements. The construction plan is finalized and the officer in charge becomes familiar with the deployment location.

The deploying Seabee unit then plans and stages all tools, equipment, and gear for the exercise. Planning is a tremendous aspect to the success of the exercise and is a major part of the training scenario. There are many issues to be raised and planned in detail before deployment, including local material procurement procedures (since most items are normally bought at the site of the exercise), hotel or tent camp requirements, offload and convoy routes, medical support facilities, medivac plans, and communication plans and requirements.

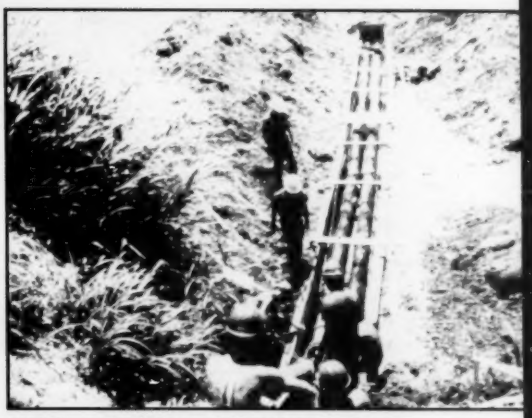
If food and resupply are needed to support a tent camp operation, food certification may be required. Many South Pacific island nations have strict procedures for importing food. Offload procedures, packing plans, and immigration and customs requirements also are issues to address.

Advance party arrival is the next major step on the larger exercise. The advance party normally arrives two to three weeks after the predeployment visit and 7 to 10 days before the main body. Advance party members will prepare and stake out the campsite, verify locally-supplied material, and attend indoctrination sessions to familiarize themselves with local customs and traditions.

The arrival of the main body triggers final tent camp construction and the start of work on the construction projects.

The amount of work accomplished on these deployments has been phenomenal. During a cyclone recovery exercise in Vanuatu (formerly New Hebrides) by Naval Mobile Construction Battalion SIXTY-TWO (NMCB-62), a roof reconstruction effort had a seven-man Seabee crew hoisting 51 wood trusses weighing more than 1,000 pounds each to the top of a school building by hand, without crane or machinery assistance. By the end of the deployment, the 24-man Vanuatu detachment reroofed the building, which was nearly the length of a football field, constructed a 23- by 64-foot concrete and CMU classroom building, and constructed a kindergarten school in the nation's capitol city. In 63 days--arrival to departure--all work was completed in time for the new term, without sacrificing safety or quality. Each building met hurricane standards, and local villagers were in awe of the level of effort by the well-behaved crews. The President of the Republic of Vanuatu, who occasionally visited one job site and talked with the crew about the project, also attended the ribbon-cutting ceremony for

Typical bridge damage caused by Hurricane Namu in Guadalcanal. Ninety-one Seabees from NMCB-3 deployed for a three-month period in late 1986 to rebuild bridges, roads, and water systems.



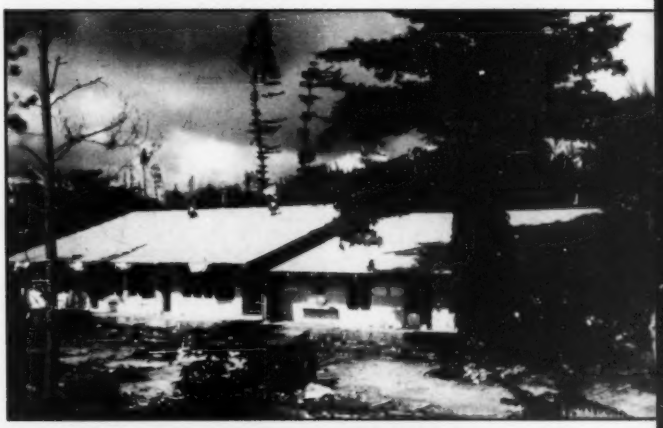
NMCB-3 Seabees prepare to construct a concrete-encased waterline under the Mataniko River in Guadalcanal.

that site's school. After witnessing the two-month construction effort, many local people told the team that they were heading for the "Seabee buildings" in the next storm!

When Hurricane Namu struck hard in Guadalcanal, a 94-man Seabee detachment from NMCB-3 responded, augmented by a three-man explosive ordnance disposal (EOD) team and a three-man preventive medicine team. The unit was transported by LST, along with 57 pieces of heavy construction equipment. In three months, they completed six timber bridges, several gabion bridge abutments, a waterline replacement including a complex underground river crossing, 150 miles of road repair, and the installation of a sterilization unit for the local hospital on the isolated island that was still feeling the effects of a major hurricane.

NMCB-3 Seabees offload equipment from LST in Guadalcanal.

NMCB-62 Seabees established a positive rapport with villagers in Vanuatu. The assistance they provided was well-received; the islanders were very appreciative of the efforts and accomplishments of the men.



Completed ecole publique school facilities in Vanuatu. Twenty-four Seabees from NMCB-62 completed three schools in the 63-day disaster recovery exercise.

REPRESENTATIONAL CRUISES

The second major type of exercise is ship representational cruises. Seabees get this opportunity when Commander in Chief, Pacific Fleet (CINCPACFLT) ships are called on to make a series of short port calls in a show of friendship with South Pacific island nations. Seabees add a unique and positive dimension to these evolutions, and despite the short two- to four-day durations of the port calls, the Seabee teams have made tremendous civic action impact on the countries involved and have become a mainstay in these CINCPACFLT South Pacific operations.

The Seabees who deploy aboard ship during these cruises experience a feel for shipboard life that few Seabees or Civil Engineer Corps officers do. Cruises have been as short as three weeks and as long as 10 weeks. Members of the team stand watches on ship, often becoming qualified watchstanders before the deployment is over, and their construction skills are very much sought after while underway. Many opportunities exist for small construction improvements or repairs aboard ship, and the Seabees soon become welcome members of the crew.

Because the port visits are so short on these cruises, much of the preparation has to be done in advance. A COMCBPAC representative conducts a survey visit about 15 to 45 days before a ship's arrival and coordinates the projects, identifies local material sources, and establishes local contacts for support. Activities and events are coordinated for the ship including ship berthing locations, itineraries of sports schedules and special events, local currency exchange availability, and commanding officer calls on local officials and dignitaries. The representative then returns to the port to meet the ship, with the Seabee construction material staged and ready on all projects.

Lt. j.g. Jack Fraser, CEC, USN presents Project Handclasp materials to needy organizations and families in Western Samoa. Project Handclasp often provides food, clothing, textbooks, and other supplies tailored to the specific islands to be visited.

Such port calls mean liberty for most ship personnel, but that's when the Seabee team is just beginning its primary mission. Seabees disembark ship in hardhats with tools in hand and ready to go, often met by literally thousands of local onlookers. Teams have built handicap access ramps for schools, screened and repaired village clinics and wards, constructed retaining walls and walkways, built school head facilities and classrooms, and roofed community buildings. They have distributed Project Handclasp goods, including food, clothing, textbooks, sewing machines, sports equipment, and medical hygiene items to needy families and organizations.

Often, ship's crewmembers have donated their liberty time to assist in the civic action efforts, helping Seabee crews with painting buildings and completing projects, and sharing in distributing Project Handclasp donations. The port call is a team effort involving a tremendous amount of activity in a very short time.

Many port visits to remote South Pacific islands have been made by ships and Seabees in the past three years, with far too many memories to possibly address in one article. One visit in July 1988, however, stands out. A 12-man team from NMCB-7 visited Tonga aboard USS BREWTON (FF 1086). Tonga is the only kingdom still existing in the South Pacific, and the King's palace is on the island of Nuku'Alofa, the port visit destination. The port call coincided with the King's 70th birthday on July 4--a five-day celebration. Ships from Great Britain, France, Australia, and New Zealand were also in port for the international celebration. Festivities included local traditional dances, a royal feast, a wreath-laying

Schoolchildren of Western Samoa display a show of gratitude with a festival of traditional local song and dance. The festival was held in a school facility renovated by a 14-man Seabee civic action team from NMCB-40 which deployed to Western Samoa for 34 days in September 1986.

ceremony, a treaty signing with U.S. representatives including Congresswoman Pat Saiki of Hawaii, and many ceremonial events.

The Seabees of NMCB-7 attended festivities only on July 5, a non-workday by law, and the rest of the five-day port visit was spent constructing new head facilities for a village primary school. Curious school children and villagers were always at the construction site, and on the last day of work, local officials, teachers, and students prepared a feast for the Seabees to thank them for the work completed during the holiday routine. Similar stories abound port call after port call from every ship cruise and on each of the many islands visited.

A special event for the Seabees on most of these ship representational cruises in the South Pacific is the crossing of the equator, a ceremony which requires all uninitiated to go through a well-planned crossing ritual rich in naval tradition. It can normally rival any college fraternity ceremony. Most Seabees can't believe they go through with it, but each is proud of making it through to become a trusted shellback for life.

CIVIC ACTION/SPECIAL OPERATIONS

Lastly, there are other discrete civic action exercises which provide training benefit and offer unique missions and opportunities for Pacific Fleet Seabees.

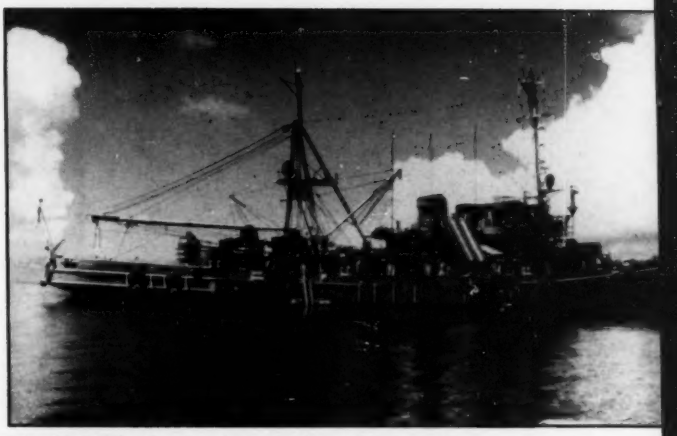
When LST transport became available in late 1986 to Western Samoa, a 14-man Seabee team from NMCB-4 deployed there to rehabilitate two schools and repair five miles of road in a 34-day deployment. (See *Navy Civil Engineer*, Fall 1986 issue.)

Then, in November 1987, Seabees repaired the Pacific War Memorial museum and monument on Corregidor. Selected from NMCB-74's Subic Bay detachment, team members set up a 60-day tent camp on the island, while they completed new concrete roofing, sandblasting, decking improvement, wall reconstruction and head repairs, to name a few projects. Corregidor stands today in raw form, symbolizing war history like no other I've seen or visited to date. It is a symbolic remembrance of past battles, and it provided a setting which reinforced a strong sense of military mission and preparedness. (See *Navy Civil Engineer*, Spring 1988 issue.)

The training benefits from all these exercises are unsurpassed and include not only good remote island construction planning and execution, but a variety of air and ship embarkation lessons aboard Air Force C-141, C-130, and C-5 aircraft as well as fast frigates, submarine rescue and salvage vessels, and transport ships.

The individual Seabee who participates in these exercises gets much more out of the experience than the needed wartime training. He goes with a very strong sense of the mission, knowing that he is an ambassador of his country. He deploys with a U.S. flag on the left sleeve of his Seabee greens and works in his field of expertise for the betterment of others, often to some of the most appreciative customers he has ever faced.

Many Seabees complete their deployments to these islands with special memories and stories of the nations and their people, memories that many Navy personnel never have a chance to experience.



The USS Florikan arrives and anchors out at Tarawa in Kiribati. Six Seabees from NMCB-7 were aboard, preparing to go ashore to accomplish civic action project tasking.

Several Seabees have told me how their experiences were the best they had ever had in the Navy. They have stated that this is what they always envisioned the Seabees were all about, and wish there were many more of these types of deployments.

Often, they become World War II buffs. It is easy to do. On most of the islands, World War II remembrances are there. Gun emplacements, Zero fighter planes, ammunition bunkers, piers, airstrips, and other war relics put history right there in front of them. The press reports how Seabees are back after 44 years. It is hard to not walk away with a strong sense of the past and an eagerness to read about legendary battles and heroics.

As the Seabees rekindle a superb reputation and again become a household word in such legendary locations as Guadalcanal, Tarawa, New Guinea, Corregidor, Ulithi, and Samoa, they are training and impressing island officials and villagers with their strong work ethics and model behavior, and have a large impact on these nations. □

A gun emplacement still standing at corregidor.

Gordon K. Jenkins

This proud Seabee veteran recounts his World War II experiences in the South Pacific

Story by JO3 JOHN-MICHAEL HALLER
Photos by JOSN BRIAN S. ELLIS
Public Affairs Office
Commander in Chief, Pacific Fleet
Pearl Harbor, Hawaii

PEARL HARBOR, HAWAII--The old man wipes away a tear and trembles at the memory of a dying native chief thanking him for saving his tribe's children. It's a scene Gordon Jenkins, a World War II Navy Seabee now living in Sacramento, Calif., says he'll never forget.

"We had been camped out in New Caledonia waiting to shove out into a combat area," Jenkins said with quiver in his voice. "During our stay, some of the guys had been throwing their extra 'K' rations. I told them 'don't throw your rations away, these little kids are starving to death. Let 'em have it.' The kids were skin and bones, and they were coming up to us saying 'gimme something, Joe, gimme nickel.'"

"Well," the old man continued, "the day came for us to move on and we were packed and just waiting for the truck to come by. All of a sudden the big chief of the whole tribe showed up, and he called me by name. He had malaria terrible. He was dripping with sweat. He introduced himself and said, 'we know you were the one that give our kids food, and we want to thank you.' He was so grateful, he came down to see me in the condition he was in, to say thank you and God bless you. I guess he died shortly after that . . . he was in terrible shape."

Jenkins was a Motor Machinist Mate First Class Petty Officer with the 25th Naval Construction Battalion, 3rd Marine Division, from January 1943 to October 1945.

Because of his age and declining health, Gordon and his wife, Alice, recently came to Hawaii to visit their daughter, Elizabeth (Betts) Radley.

The Jenkins also visited the USS Arizona Memorial where Gordon said goodbye to his best friend from high school, Marvin J. Shugart, who died in the Dec. 7, 1941, attack on Pearl Harbor.

It was a sad thing about Marvin," Jenkins said quietly. "Not too long before he went into the service his father died of zinc poisoning. That left a mother and three sisters, and Marvin had to support them on about $54 a month. He wrote back and told everyone how he liked the Navy and all and he sent his mother his checks to keep the family going. Then to have that happen . . . He was a good kid."

While at the Arizona Memorial, Elizabeth gave her father an American flag that had been flown above the sunken battleship. Tears filled their eyes as they embraced.

Alice proudly pointed out that his daughter had also spent 12 and a half years in the Naval Reserve.

Elizabeth nodded agreement, and added, "I was about nine when Dad went to Norfolk, Virginia, for boot camp . . ."

The very mention of boot camp and Seabee training in Virginia brings a smile to the face of the 78-year-old. "We had a rhyme that was really the only way to describe training in Virginia:

> I was trained in dear old Virginia
> The land that God forgot,
> Where the mud if fourteen inches deep
> And a rain that never stops.
> And when he gets to Heaven
> To Saint Peter he will tell,
> Another Seabee reporting, Sir,
> I've served my time in hell."

From Norfolk, Jenkins and his fellow Seabees traveled to Port Hueneme, Calif., then to Camp Elliot, San Diego.

"Until he went into the service," Alice interjected, "we had been living in Canon City, Colo., Gordon's hometown. When he left I took Elizabeth and her two-year-old brother, William, and moved to Glendale, Calif., to live with my mother. We had only been there a short while when Gordon got assigned to Camp Elliot."

There the funniest thing happened, according to Alice, when Gordon came home from Camp Elliot and went to church that Sunday in his Navy uniform. "One of the old ladies of the church says to Betts, 'Who's that man with your mother?'

Elizabeth says, 'that's my daddy.' "

"Well, the next Sunday he came up and he's got a Marine uniform on because he was reassigned. The old gal tackles Betts and says 'who's that man with your mother?'

Elizabeth says, 'that's my daddy.' "

"Well, the old girl was so flustered," laughs Alice, "that all she could ask was, 'how many fathers do you have?' "

Although Elizabeth did have one father, he had two uniforms.

Gordon Jenkins and the 25th Naval Construction Battalion had been attached to the 3rd Marine Division, headed for the South Pacific. The first stop, Bougainville. Here, he spent the Christmas of 1943 dealing with the Japanese, Tokyo Rose, and a smoking volcano.

"We were worried about the volcano," he said seriously. "there was some smoke and a good vibration, and the vibration rattled loose some coconuts that we were all dodging. But then, all of a sudden we realized that Japanese were having the same earthquake," he chuckled. "We didn't feel quite so bad about it then."

Then there was Tokyo Rose.

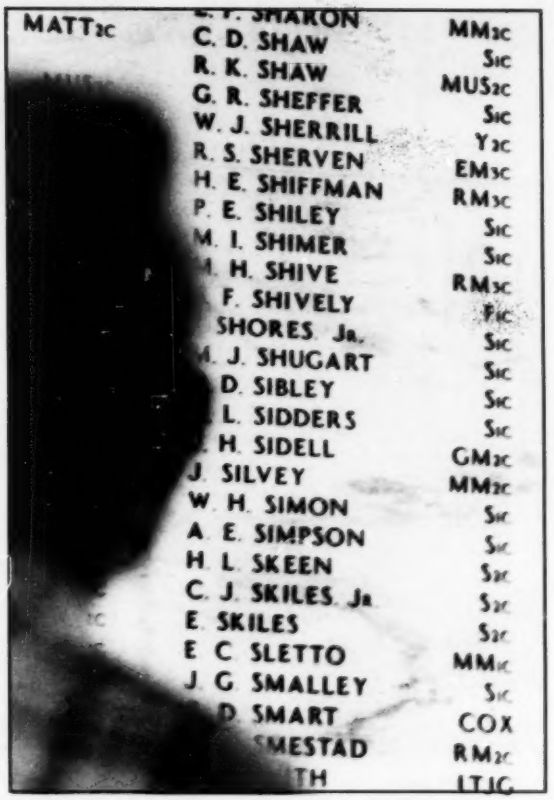
She (Tokyo Rose) would give a name and say, 'We know where you are.' Or sometimes Gordon would hear, '25th Seabees, you're not hiding. We know where you are.' Some nights she'd says such things as, 'Hey, fellas, where do you suppose your wives are tonight, and what are they doing?' It was demoralizing for some of the guys," Jenkins noted, but added, "I don't think it affected us all that bad."

However, some things did affect the lives of the Seabees, like fighting side by side with the Marines when casualties depleted their numbers.

On Bougainville, the Seabees named a bridge in the memory of one of their own who died during a Bougainville operation. "The Marines were first and we were second and sometimes, when they got thin, were were first with 'em. There were some pretty rough landings, and it took a few nights to get everything secured," he added sadly.

Jenkins noted respectfully, "The Marines are a good bunch of boys, they really are. And I think they had a great amount of respect for us. We made it possible for them to go in and do the things they needed to do, and to get their supplies in." To show their appreciation of the 25th Seabees, the 2nd Raider Regiment, of the 3rd Marine Division, erected this sign on Bougainville:

> So when we reach the 'Isle of Japan'
> With our caps at a jaunty tilt
> We'll enter the city of Tokyo
> On the roads the Seabees built.

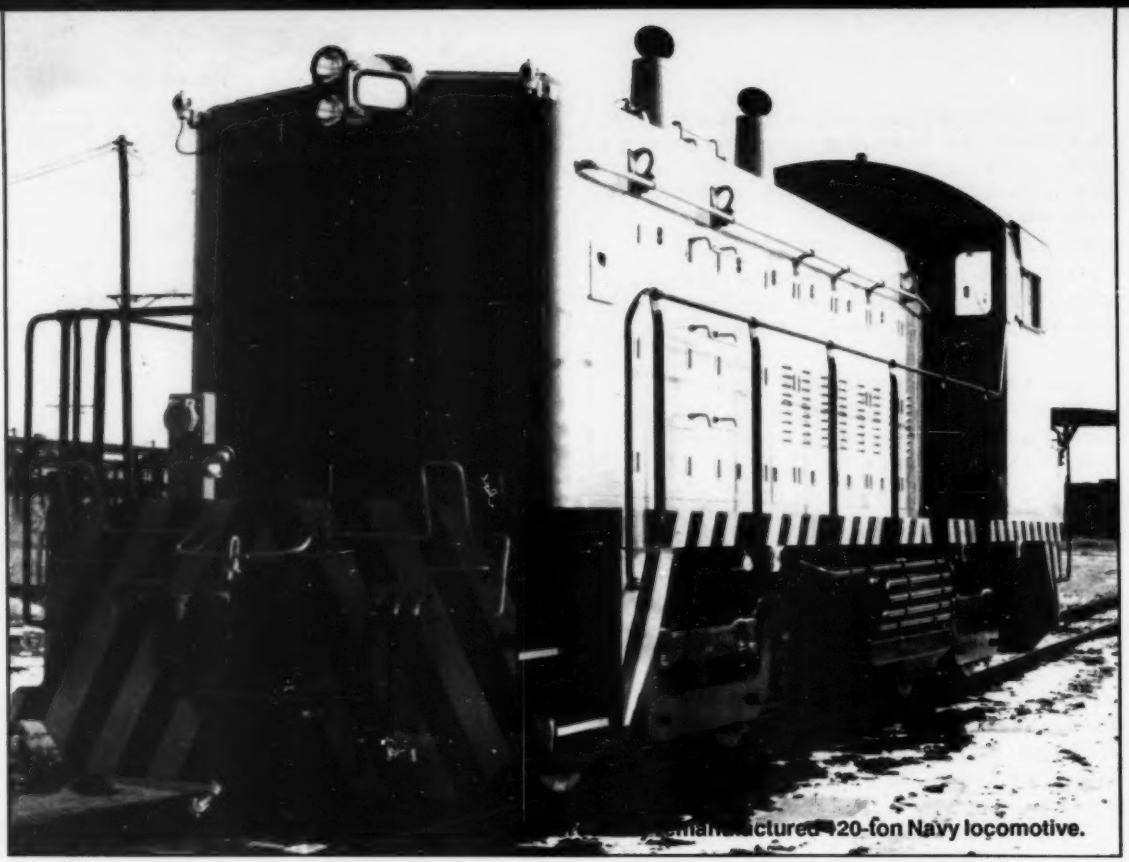


By Jan. 7, 1944, the Seabees had left Bougainville for Guadalcanal, and by September of that year they had moved on to Guam.

The 25th Construction Battalion Diary recounted the Seabees' Christmas of 1944 on Guam. The war-ravaged island was severely lacking in basic necessities, and toys for the local children were not to be found. So the Seabees set to work, making dolls stuffed with cotton from an old mattress and toy jeeps from discarded lumber. Candy donated by the men from their own holiday boxed completed the gifts, and a Seabee Santa delivered it all to 75 excited children form a local village.

Gordon Jenkins remembers well the destitution of the natives throughout the South Pacific. He despondently tells of watching villagers dying of various diseases, and lacking in food and clothing. "We would move in and take over and they would suffer for it temporarily as we tore up the land they had depended on for years. But, our work was good. It wasn't built for just a couple three days. It was built to last."

By October 1945 Gordon had been honorably discharged and was home once again with his family, the sights and sounds of war just a memory. But some memories shall not soon be forgotten, as some good deeds shall not go unthanked. Through all the memories, good or bad, Gordon Jenkins will tell you, "we did what we had to do." □



...ctured 120-ton Navy locomotive.

The Navy's internal railway system strengthens defense logistics capability

By WALT HILSABECK
Manager, Railway Programs
Chesapeake Division
Naval Facilities Engineering Command
Washington, D.C.

INTRODUCTION

One of the most important and least heralded material transportation systems existing in naval activities is the Navy's internal railroad system. These railroads provide the major source of transport for explosives and ordnances being loaded aboard fleet warships and for the movement of ship repair material, maintenance material, fuel, oil, water, coal, scrap, and various other items in support of base operations.

BACKGROUND

The Navy owns and operates 100 locomotives and 2,500 railcars operating on 1,200 miles of internal trackage at 35 separate activities. These include naval weapons stations, naval shipyards, public works centers, supply centers, air stations, construction battalion centers, and fleet operating bases. In an average year, 175,000 separate car movements are made at these activities.

Taken as a whole the Navy operates the 28th largest railroad in the United States. These railways are under the cognizance of the station public works department and the trains are manned by civil service engineers, conductors, and brakemen.

FLEET RESTORATION

In the early 1980s the Naval Facilities Engineering Command (NAVFAC) recognized the necessity of up-

grading the Navy locomotive fleet to restore the aging units to sound operating condition. Considering that each new switching locomotives cost about $1 million, a program of restoring the existing units by total remanufacture was initiated. This type of equipment rebuilding and restoration is standard practice in the railroad industry. Remanufacturing a railway locomotive can be done for about one-third the cost of a new unit and adds 20 to 25 years to its lifetime.

NAVFAC assigned this project to its Chesapeake Division (CHESDIV) for planning and execution. Through a joint NAVFAC/activity funding effort, CHESDIV Transportation Equipment Management Center (TEMC) personnel initiated a program to have the majority of Navy railway locomotives rebuilt by commercial contract at various railway locomotive repair shops throughout the United States. To date 46 units have been completed and returned to service and 17 additional units are currently under contract. The program will continue until about 85 locomotives have been remanufactured. In addition, seven Marine Corps and two Defense Logistics Agency locomotives have been remanufactured under CHESDIV management.

The Navy operates the 28th largest railroad in the United States.

The remanufacture of a Navy locomotive consists of complete disassembly, replacement of the diesel engine with a new or rebuilt unit, rewinding of the main generator and traction motors, replacement of all electrical control components and systems, installation of a modern air brake system, new wheels, new roller bearings, and numerous other items of restoration to bring the units into compliance with current Federal Railroad Administration safety standards. CHESDIV technicians prepare the contract specifications, assist in evaluating the bids, get the locomotives moved to the contractor's facility, monitor the work in progress, perform the final acceptance tests of the locomotives and get them delivered to the using activities.

Locomotives

The Navy locomotive fleet consists of four basic size units: 120 ton/1,200 horsepower; 80 ton/500 horsepower; 65 ton/400 horsepower; and 44 ton/380 horsepower. A locomotive on steel wheels achieves its pulling capacity from its weight and its speed or rate of doing work from its horsepower.

These various size locomotives are assigned to activities based upon the maximum number of cars to be moved and the track terrain. Curves and grades in the railbed consume a significant mount of the locomotive power and are a key factor in locomotive size selection. Ideally a locomotive achieves a tractive effort (draw bar pull) of approximately one-fourth of its weight. Therefore a 120-ton locomotive will exert a pull of 60,000 pounds. This effort is used to overcome the rolling resistance of the railcars being pulled in the train. Railcars in motion have the following resistance factors:

Friction resistance--10 pounds per ton

Curve resistance--0.8 pounds per ton per degree of curve

Grade resistance--20 pounds per ton per percent of grade

Using these factors, the moving resistance of a 10-car train with each car weighing 80 tons going around a 5-degree curve on a 2-percent grade would be calculated as:

800 tons x 10 pounds per ton friction resistance	8,000 pounds
800 tons x 4 pounds per ton curve resistance	3,200 pounds
800 tons x 40 pounds per ton grade resistance	32,000 pounds
Total resistance	43,200 pounds

This load would require a 120-ton locomotive to effect movement under the above-listed conditions. A lighter locomotive would stop forward motion and spit its wheels on the track when the train resistance became equal to its maximum available tractive effort.

The speed at which the load would move (at maximum power setting) is computed from the following formula:

$$\text{Miles per hour} = \frac{\text{Horsepower} \times 375}{\text{Tractive effort}}$$

$$= \frac{1{,}200 \times 375}{43{,}200}$$

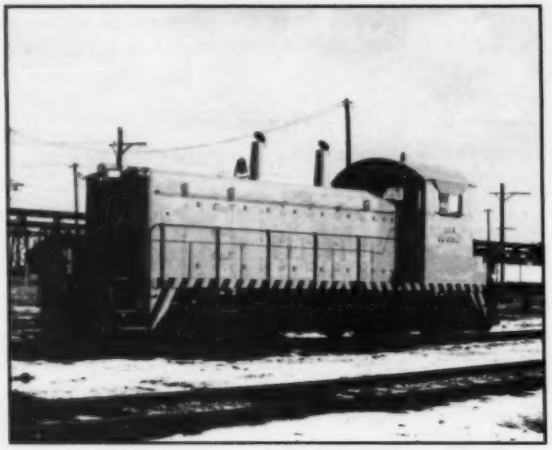
$$= 10.4 \text{ miles per hour}$$

Both pulling power and speed can be increased by placing additional locomotives on the train. This is often noted on commercial railroads where two, three, and four locomotives are used to provide the necessary power requirements.

Railcars

The 2,500-car Navy rail fleet consists of box cars, flat cars, tank cars, gondolas, hoppers, and a few coaches and cabooses. These cars are operated exclusively on Navy property in captive service and do not run on the interchange railroads. The cars have an average age of 40 years, which is 15 years beyond their rated life expectancy and an age which requires mandatory retirement were they not in captive service.

Although Navy railcars do not experience the long mileage and rough handling of commercial railroad service, they are gradually deteriorating from age. In addition,



A recently remanufactured 120-ton Navy locomotive.

they do not meet all of the current safety standards established by the Federal Railroad Administration (FRA) for cars used to move class A explosives and other hazardous material.

CHESDIV recently instituted a pilot program to evaluate the railcar assets of all Navy activities and initiate a railcar revitalization program to restore the fleet to sound operating condition. This program will entail readjustment of the on-board railcar allowances, restoration and upgrading of a large number of the cars by commercial contract, and replacement of cars no longer worthy of being rebuilt.

In the case of cars used to move class A explosives this will mean the elimination of cast iron wheels, conversion to roller bearings, conversion to composition brake shoes, and the addition of spark shields. It is estimated that a railcar can be completely rebuilt and restored to sound condition for about one-third of the cost of a new car. This program will take five to eight years to complete and will result in a railcar fleet which will meet current FRA safety standards and will add an additional 25 to 30 years lifetime to the cars. Funding for the majority of this program must be derived from the asset capitalization program of the using activities.

OPERATING HANDBOOK

Due to a recent re-emphasis of railway operation safety aboard Navy activities, NAVFAC has tasked CHESDIV to develop NAVFAC P-302, *Navy Railway Operating Handbook*. Currently there is no Navywide standardization of railway operating rules and practices. Each railway operating activity must now obtain its own guidance from numerous documents published by federal agencies and railroad industry associations.

When the handbook is published, it will provide Navy activities with a single-point reference for establishing railway operating and maintenance procedures. It will address such items as speed limits, crew size, crossing safety, maintenance frequency, and numerous other areas related to rail operations. The handbook is being developed by a joint effort of CHESDIV and the U.S. Department of Transportation. It is scheduled to be ready for distribution in February 1990.

TRAINING

The CHESDIV TEMC also serves as the coordinating agency to train Navy railway locomotive engineers and trainmen on a locomotive simulator facility developed for the FRA by the Illinois Institute of Technology at Chicago. There the trainmen receive instruction in the techniques of train handling and the new types of systems being installed on the remanufactured locomotives. A link trainer-type system is used where the students get the fleet, motion, and noise of a locomotive cab and see the passing track and terrain on a five-screen projection. To date over 100 civil service railway engineers have received training at this facility.

> Railroading is a unique operation with a language and customs of its own . . . It can be a dangerous business if not properly conducted.

Civil Engineer Corps officers receiving an assignment of a naval weapons station, naval shipyard, or other type of railway operating activity are faced with the new challenge of managing rail equipment. Railroading is a unique operation with language and customs of its own and at first can be intimidating. It can be a dangerous business if not properly conducted. The new manager should acquaint himself or herself with the peculiarities of this operation as soon as possible. This can best be accomplished by a careful examination of station railway operating directives, discussions with rail operation supervisors and train crews, and riding the locomotives during actual switching operations.

SUMMARY

The Navy railway systems are an integral part of the national defense logistics capability. Upgrading and maintaining this equipment will ensure that tactical and strategic defense material and many other commodities necessary for Navy operation will continue to move "on time" over Navy rails. □

Military bearing: How important is it for a CEC officer?

By LT MASON CRUM, CEC, USN
P.E., Minn.
Instructor, Military Readiness Division
Naval School, CEC Officers
Port Hueneme, Calif.

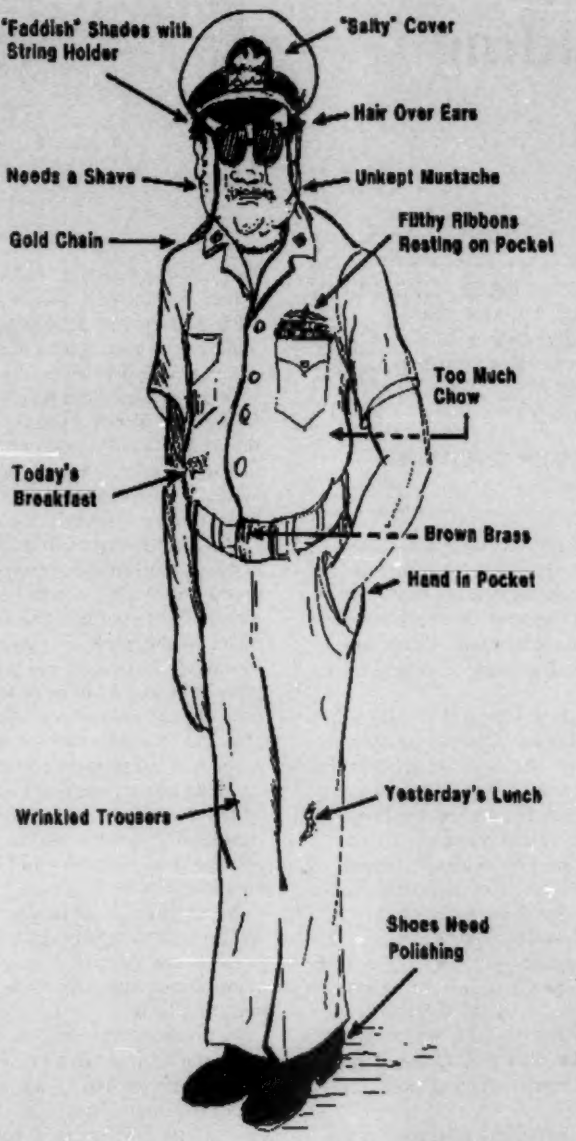
Just how important is military bearing to a staff Civil Engineer Corps (CEC) officer? Or a better question might be, how important is perception of our military bearing?

Taxpayers' perception

In your contacts with the local community have you had the opportunity to tell your neighborhood taxpayers what an exceptional job you've been doing managing your facilities support contracts and negotiating change orders? Probably not. Are they informed enough to care? Probably not. They determine whether their hard-earned money is being well-spent by Uncle Sam by how "squared away" you appear. If your brass is brown and your shoes are scuffed, what does the public think?

Fleet's perception

"Ah, the life of a staffer. No seasickness, family separation, or responsibility--doing a civilian's job in khakis." Do you suppose anyone could have this perception? There are numerous variables in this equation but none weigh heavier than the image we portray in uniform. Do you look like an officer that is dedicated to the defense of the country or do you lack the discipline to keep yourself in peak physical condition?



Subordinates' perception

Few CEC officers have the opportunity to serve with the Navy's finest: the Seabees. Everyone has heard that a leader must "set the example," but they must also be aware that they not only set the standard, they *are* the standard. If the leader of a unit has hair over his ears then it becomes immediately acceptable for the members of that unit to do the same. To expect more of your troops than you do of yourself is hypocritical.

You may not agree with this assessment of the importance of perception or impressions, but it is we must recognize that a first impression happens only once--and it may be our last! □

Reducing confusion in the bidding process

Story by CAPT RICHARD H. PRICE, CEC, USNR
P.E., Ark., Ill., Ind., Ky., Mo., Tenn.
Commanding Officer
Reserve Naval Construction Battalions
Atlantic Fleet
Norfolk, Va.

Artwork by JENNIFER G. HUTSON
Oxnard, Calif.

THE JOB IS LATE, some of the workmanship is shoddy, bonding companies are arranging for completion of work abandoned by more than one defunct subcontractor, and the owner and general contractor have gone through two project managers each. There are liens, lawsuits, and acrimony all around . . . only the lawyers are winning this one.

What happened? Why did the job go sour? It could be incompetence, not enough money, poor management, and lack of skilled manpower. The odds are are that the cause has to do with lack of money on the general contractor's (GC's) part. He or she bid the job too low, can't pay what it costs, and is cutting corners.

The commercial building industry is highly competitive. It's not unusual to have a dozen or so general contractors bidding on a $2 to $10 million dollar project. The bid spread on a project like this may be substantial, but the responsible bids are usually quite close. I've seen many with a standard deviation of less than 3 percent. This is not surprising since most projects of this type are 70 to 90 percent subcontracted, most GCs are using the same major subcontractor bids, and most GCs will add between 3 and 6 percent for direct overhead, profit, and contingency.

Generally speaking, a simple project with good plans, specifications, and bidding documents and no excitement will result in very tight bidding, with the outcome determined by which GC thinks they can be most efficient with their own work, managing the project, and their willingness to work with a low profit margin. This is what the competitive bidding process is all about.

With confused bidding, however, people make mistakes--subcontractors make busts, and GCs have gaps in their bids or arithmetic errors. The bigger the confusion factor, the greater the chance for more and worse errors. When the low bidder leaves 5 percent on the table, you know they've submitted a confused bid.

An astute owner will let Mr. Confused GC off the hook. Unfortunately, many owners' eyes glaze over with greed. After all, 5 percent of $5,000,000 is a lot of money! The confused low bidder will usually not ask to be let off the hook. For one thing, their bid bond may be at stake (a 20 percent bid bond is absurd). And then there's the matter of pride and the prospects of cash flow, change orders, and "buy-out." (For the uninitiated, "buy-out" includes savings realized through the unethical process of bid shopping after the fact.)

As an owner, you don't want a GC that is forced to try and break even or make money on change orders and "buy outs." Anyone who knowingly gets a GC in this position is an accessory and will have the examples I mentioned in the first paragraph happen to them.

So let's talk about confused bidding and what owners and architects-engineers (A-Es) can do to make the confusion factor as small as possible. The measures are quite simple--common sense to people who put together bids for a living.

As an owner or A-E, you may not have even thought about the subject. In a previous job in my civilian life I worked with an A-E. I was a project manager and have committed many "no-no's," thinking all along that I was acting in the owner's best interest and not realizing that I was injecting confusion into the process.

Bid Day Activities

I'll set the stage for discussing what causes confusion by describing "bid-day" activities. Having only worked for one general contractor, I can't say that this description applies to every GC, but I assume we all do about the same thing.

By Bid Day 1, you've gotten your in-house work taken off and priced. The general conditions (direct overhead costs) have been estimated, your bid summary is in the personal computer (PC), waiting for subcontract bids, and the A-E has called with their last addendum.

Your bid bond is in hand. The bid form and envelope are ready for filling in, and you know who is going to man the phones and who is going to deliver the bid. You've gone over the scope sheets received from subcontract trades which customarily hand them out. Structural steel subcontractors, for example, customarily send out a two- to three-page document listing what items they will furnish, what items they will install, and what items they exclude.

Suppliers of miscellaneous division 10 items tell you what sections they will bid; the door people tell you how many of what kind of doors they are quoting. From these sheets, our estimates, and the specifications index, we prepare a matrix card for each division, listing discrete work packages, which are usually specification sections on the vertical axis. In the case of structural steel, miscellanous metal, millwork, and similar items, the work packages are broken down into listed pieces/categories of material. The horizontal axis gets filled in with the names of the subcontractors/material suppliers as their bids are called in.

The bid summary (which we have on a PC) lists all of the specification sections or work packages, by division with further breakdown as required. The bid summary is programmed with everything needed to produce a complete estimate: payroll tax and insurance rates, sales tax, bond rates, liability insurance, building permit formulas, and the fee mark-up percentage. It is also set up to produce "by division" per-square-foot costs for information purposes, and bids for any alternates involved.

I get as much of this I can into the PC on Bid Day 1, including our in-house work estimates, and "plug" numbers we've estimated for work packages we're not sure we'll get subcontractor coverage on. All of the matrix cards go into hanging file envelopes tabbed with the division number. The idea is to be set up for speed, efficiency, and accuracy. The PC bid summary has cross-checks built in and enough dry runs have been done to know it's programmed right.

Bid day morning arrives. No matter how many times you've done it you still get butterflies. You get to work early and do what double-checking you can before the phones start to ring. All the people taking phone calls are briefed on job peculiarities and appropriate questioning for subcontractors who may be affected. Everyone has a pad to take down scope (if a scope sheet hasn't been submitted), addenda acknowledged, materials furnished or furnished and installed, tax, exclusions, qualifications, subcontracting bidder's name, phone number, and company. During the morning, it is not unusual to get 100 to 200 telephone bids.

The phone bid sheets go to the person who has the job of entering them on the matrix cards. If the job has been set up correctly, the bids will correspond to one or more work packages within a division so that a study of each card will indicate the lowest combination of bids and there will be no gaps or duplication of work.

Interestingly, the time that various trades tend to call in their bids is fairly predictable. Some kind of pecking order is at work. Our calls usually start with the small specialty items, progress through the finish trades and site subcontractors to the masons and structural steel people, and then finally to the electrical and mechanical subcontractors.

The standard bid opening time is 2:00 p.m. The electrical and mechanical subcontractors, which typically make up 15 to 20 percent the job, never call before 1:00 p.m., which is good because that's when the steel people start to call. The electricians and plumbers can't get quotes out of their suppliers until late, so their bids start at about 1:15 p.m. and conclude at 1:55. But most of the heavy phone volume has subsided by noon, and most of the bids are on the matrix cards.

Then we're on the phone with various subcontractors trying to clarify bids and trying to "plug holes." Aside from an occasional toilet and bath accessory salesman calling in with a long list, we're waiting for the major ones and checking what we have. At 1:15, we've just about finished putting the apparent low subcontracting bids from the matrix cards into the PC.

The lull in the action is short, however. The big numbers come quick, are evaluated, and go into the machine. We get a total, and the boss decides the adjustment. His or her judgment (or "J" factor) depends on a number of things: our perception of quality and completeness of the bidding documents, the number and spread of major subcontracting bids, coverage, time and liquidated damages, complexity, owner's reputation, the competition, and of course, our current workload situation and profit objectives. The bid amount is decided, along with numbers to put in other blanks on the bid form which may include alternates, a schedule of unit prices or a listing of major subcontractors.

The telephone bid taker has been holding on the phone for at least 10 minutes. More often than not, just before the final bid is relayed over the phone, a major subcontractor will call with a significant cut. Our bid is usually delivered with less than two minutes to spare.

Estimating and bidding is fun. It's a short-range challenge to the intellect and experience. You don't spend enough time on one project to get tired of it. And "bid day" is almost exactly like an athletic contest. It's a team sport with all of the thrill of winning and the agony of defeat. It's sweat and white knuckles; at the end of the game, you know who won and by how much. The difference between bidding and a football game, of course, is that you don't know how the others are doing during the game, and winning by too much is worse than losing. Another difference is that the rules for a football game are fairly static. The bidding game is not always that way. Bidding is exciting enough as it is without a lot of confusing rule changes.

I hope this description has conveyed the fact that on bid day, an enormous amount of information must be received by telephone, written down, analyzed, assembled, and acted on in a short period of time under a great deal of pressure. Under the best circumstances, there are many opportunities to make a mistake or an error in judgment. It's a trade joke, but with a long bidders' list, the presumption is that the low bidder is the one who made the biggest mistake. Unfortunately, it's often true, and it isn't funny to the low bidder or to those who wasted time preparing a good bid.

Guidelines

With all the potential for error inherent in the bidding process, don't add confusion!

1. First and foremost, don't have a lot of alternates or bid items. The confusion factor increases exponentially with the number of these things.

   a. The interfaces between the base bid and alternates are often unclear.

   b. The telephone bids take longer and are more complicated.

   c. The analysis phase is complicated.

   d. It takes longer to enter the bids and the chance of a wrong number into the PC is multiplied. (Often, data entry errors are off by a factor of 10.)

   e. The chance for a programming error on the bid summary increases.

   f. If you feel you must have an alternate or two to ensure getting the project in budget, try and pick alternates that involve only one or two trades. An alternate type roofing system, for example, is much easier to handle than cutting a wing off a building. What is ridiculous is to ask for alternates--actually bid items--not for the purpose of getting a project in budget but for the purpose of curiosity. If you need to know how much a particular component is worth, ask after the bidding when your contractor can do it right under a nonpressure situation.

2. Finish the contract documents before putting the job out for bid, and leave a week between the last addendum and bid day. When a job has more than two addenda, no one can assimilate all the changes and make an accurate estimate. Half the subcontractors haven't seen them all which presents the general contractor with a big problem during bidding.

When drawings are revised, draw a circle around the changes so the bidders will know what's been changed. I know of a case where an addendum came out which said "on page two of the Section 00100, change 3:00 to 2:30." One of the bidders failed to notice the fine print and turned his bid in a half-hour late. With something this basic and this important, wouldn't it have been appropriate to simply state, in capital letters on the first page "NOTICE THAT TIME FOR OPENING OF BIDS IS CHANGED FROM 3:00 P.M. TO 2:30 P.M."?

A-Es frequently issue a massive addendum right before bidding to correct errors found during the estimating process. While this may get the A-Es off the hook with the owner, it has added to the confusion factor and done no one but himself any favors.

3. Have bid openings at a standard time: 2:00 p.m. Once set, don't change it, and never make it earlier.

4. Don't change the location of the bid opening.

5. Check with the planning areas. Don't schedule your bid day on top of other projects. Try and stay two to three days away.

6. Clearly state:

   a. Who pays for the building permit.

   b. Who pays for builder's risk insurance.

   c. Who pays for utility fees. If the contractor is responsible, the use of an allowance item is often best since most utilities won't quote these fees to bidders.

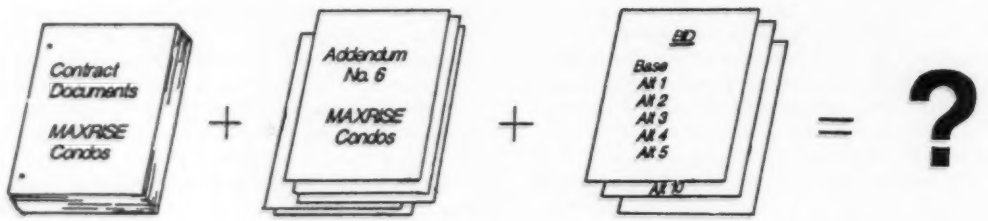
   d. Who pays for impact fees.

   e. Who pays for testing.

7. Contract document or not, include a copy of the soils report along with the bidding documents. Don't make every GC and dirt subcontractor chase one down. It's a silly game and wastes a lot of valuable time.

8. Maximize trade and specification section correlation. Don't take the attitude that the GC is responsible for everything in the specifications. Commercial construction is much too complex to support that simplistic position. The fact is, most subcontractors bid by specification section. If a specification were written so that each section perfectly correlated with a trade (i.e., each section only involved one trade and everything in the job was covered in the specifications), then the GC's bid would have no duplications and no gaps. And more importantly, the responsibility of each subcontractor would be clearly defined. Isn't that a worthy objective?

The only person who has control here is the specification writer, who can be specific in assigning responsibil-



ity. For example, there will probably always be a specification section on insulation, although there is usually no one subcontractor that will do everything in that section. So why not state in that section that the drywall subcontractor will be responsible for the batt insulation in the walls, the GC for the perimeter insulation, etc., and cross-reference the responsibilities in the drywall and concrete sections?

If the only metal studs you have on the job are part of the gypboard wall system, put them in that section. If there is other framing with structural studs not associated with gypboard, write a separate section, but assign it to the subcontractor who according to local practice is best suited to do it. If you don't, chances are it won't be covered and the GC will cover it with a guess on bid day. If the local practice is for the drywall subcontractor to tape, mud, and finish the drywall, put that in the drywall specification. If the local practice is for the painter to do it, assign the responsibility there. Who normally does the thru-wall flashing? Who caulks the door frames? The windows? The bathtubs? Who paints the piping? If the painter is supposed to, don't put it in the mechanical specification.

9. Don't charge a plan deposit of much more than cost. When you charge $1,500 for a set of plans, it does more than keep out the riff raff. It has a number of unpleasant results. The number of plans in circulation goes way down. The number purchased by GCs is cut in half, and the subcontractors just won't buy them. As a result, people lie, steal, and work weekends and nights with partial sets. Does this inconvenience get the owner a better product or a better price? No, it does the opposite. Does it get the A-E more money? Yes.

10. Use standard general conditions as published by AIA (or NSPE or AGC). Make changes using supplementary general conditions. Try and minimize the number of changes and don't retype. When you do this, it's hard to find the changes. Bidders don't have time to read the general conditions in detail. We're familiar with the standard AIA document. What we're looking for are the changes.

11. Be realistic with completion times. Setting them too long or too short can both cause problems. If there is a real need for a facility by a certain date--a dormitory by August 15, for example--put a lot of thought and get advise on the optimum construction period and plan accordingly with high liquidated damages.

For less urgent situations, ask for the time of completion as part of the bid, and make the time part of the evaluation criteria. Let the GC determine the optimum time, and be realistic with the damages. The confusion factor with a short completion time is that the subcontractors will bid it as if they have all the time they need. That makes it very difficult for the GC who has to assess the cost impact of an artificially short schedule.

12. A selective, invited bidders list of no more than five or six general contractors will do two important things: it will assure the owner of a good, low price by a contractor they've selected as acceptable, and it will reduce the chance of getting "the one who made the biggest mistake." Select contractors known for their integrity and track record and who have professional, experienced personnel available to manage the job. Use the same care in putting together your selected bidders' list as you do selecting your A-E--it's every bit as important.

13. Require that bidders list their major subcontractors with their bid. This reduces the possibility of bid shopping. It tends to put the bidders on an even footing, since some bidders will submit a low bid betting they can find subcontractors to take the job for less once the pricing is generally known. Also, knowing the prospective subcontractors gives the owner additional selection criteria.

Summary

- Opportunities abound for mistakes during the bidding process.
- The consequences of serious mistakes are serious not only to the GC, but also to the owner, A-E, and subcontractors.
- Chances for A-E and owner contributions to bidding mistakes can be reduced by considering the 13 "do's and don't's." □

Bidding Do's and Don't's

1. Absolutely minimize alternates and bid items.
2. Minimize addenda and send the last one out at least a week before bid day.
3. Use a standard bid opening time. Don't change it, and if you do, never make it earlier.
4. Don't change the location of the bid opening either.
5. Don't schedule your bid day on top of other projects.
6. Clearly state who pays for permits, builder's risk insurance, utility fees, impact fees, testing.
7. Include a copy of the soils report in the specifications.
8. Maximize specification section/trade correlation.
9. Don't charge an arm and a leg for bidding documents. Instead, try and maximize distribution.
10. Use standard (AIA) general conditions with minimal changes via supplemental and special general conditions.
11. Be realistic with completion times and liquidated damages. Let the GC submit their time for completion as part of the bid if possible.
12. Use a selective, invited bidders list of four to six GCs if possible.
13. Require that GCs submit names of their major subcontractors with their bids.

If you find other opportunities to reduce confusion during bidding, utilize them! They are painless and the least expensive project insurance you can buy.

SOUTHDIV develops contracting method to obtain lowest life-cycle cost for mechanical systems

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The Southern Division (SOUTHDIV) of the Naval Facilities Engineering Command (NAVFAC) has developed a contracting method which goes beyond the usual low-bid, lump-sum construction cost procedure. The method, which has been applied with success, considers bids for initial construction, operations, maintenance, repair, and energy consumption. Higher-quality equipment was obtained with an accompanying 10 percent reduction in life-cycle cost.

The Military Handbook 1190, *Facility Planning and Design Guide*, in chapter 10 sets forth the general policy that mechanical systems should be obtained at the lowest life-cycle cost. NAVFAC engineers who are experienced in procurement of energy-consuming systems realize that our normal bidding procedures don't always lend themselves to meeting this lowest life-cycle cost objective. If, before bidding, the engineers determine what equipment has the best life-cycle cost considering the three main factors--initial cost; operations, maintenance, and repair costs; and energy cost--and then specify that equipment, they restrict competition. This restriction leads to problems: (1) manufacturers complain that our bid package is proprietary, or (2) the specified manufacturer, realizing a favorable bidding position, artificially raises the price.

SOUTHDIV has developed a contracting method which considers these three life-cycle factors without the unfavorable problems. The method has been successfully used to procure two central chilled water plants at the Marine Corps Recruit Depot, Parris Island--total capacity 1,100 tons--and to replace a 500-ton absorption chiller at the Naval Station Charleston with a centrifugal unit. Based on these successes, an instruction has been issued, SOUTHNAVFACENGCOMINST 4330.71, giving the procedure to be followed in preparing a life-cycle cost bid package.

The method requires the prospective contractors to submit bids for the initial installation (first cost), and for up to four years of maintenance, operation, and repair (OM&R) awardable at the option of the government. The contractors are also required to submit with the bids the energy their equipment will consume based on a yearly load profile specified by the government. This bid energy consumption is verified by appropriate factory test after award of the contract, and the specification requires a unilateral cost adjustment if the bid energy consumption is exceeded. The first cost, OM&R costs, and annual energy costs are entered by the bidders into a specified equation which converts all the factors to a present value (life-cycle cost, or LCC).

Contract award is to the low LCC bidder, who is not necessarily the lowest first-cost bidder. The results from the Naval Station Charleston chiller replacement are shown in Figure 1.

During the design phase of the project, the LCC equation to be specified was derived using a one-year construction time, a 20-year equipment life, and four separate one-year OM&R options. The basis for the equation was *Energy Prices and Discount Factors for Life Cycle Cost Analysis*, which is an annual supplement to National Bureau of Standard's *Handbook 135 and Special Publication 709*. Tables in this publication give present worth factors for geographical location, type of fuel consumed, and equipment life. The equation for our project was:

LCC = (.91) 1st cost
+ (.83) 1st year's OM&R
+ (.75) 2nd year's OM&R
+ (.68) 3rd year's OM&R
+ (.62) 4th year's OM&R
+ (6.5) yearly energy cost

Section 00101 of the specifications for the project included worksheets for completion by the bidders. The worksheets with the values submitted by the low bidder are shown in Figure 1.

The successful equipment manufacturer, after award of the contract, advised that their bid on a life-cycle cost basis would compare to their bid for the same project on a conventional lump-sum, first-cost basis as follows:

	Life Cycle	Conventional
a. 1st cost	$298,625	$273,625
b. 1st year's O&M	$15,060	$14,560
c. 2nd year's O&M	$22,308	$21,808
d. 3rd year's O&M	$22,308	$21,808
e. 4th year's O&M	$23,712	$23,212
f. Yearly energy cost	$51,578	$67,052

Using the derived present worth factors, the LCC was obtained as follows:

	Life Cycle	Conventional
g. (.91) 1st cost	$271,749	$248,999
h. (.83) 1st year's OM&R	12,500	12,085

ENERGY COST WORKSHEET NO. 1

COST SUMMARY

INSTRUCTIONS: Use Data From Energy Cost Worksheets 2, 3, and 4.

A. TOTAL ENERGY COST FOR COOLING PLANT:

1.	Energy Cost for Chiller	$ 27558.7
2.	Energy Cost for Cooling Towers	$ 4252
3.	Energy Cost for Pumps	$ 19768
4.	Total Energy Cost (Lines 1+2+3)	$ 51578.7

NOTE: Enter line 4 of this worksheet on line 6 of the Life Cycle Cost worksheet.

ENERGY COST WORKSHEET NO. 2

CHILLER ENERGY COST

A. CHILLER ENERGY CONSUMPTION:

INSTRUCTIONS: For each load, multiply the Hrs./Yr. by the chiller Amperes from the Load Profile Worksheet.

	LOAD	HRS./YR.	x	CHILLER AMPERES		
1.	48 Tons	583	x	49.1	=	28625.3
2.	72 Tons	153	x	46.4	=	7052.8
3.	97 Tons	307	x	56.0	=	17192.0
4.	121 Tons	186	x	65.0	=	12127.2
5.	145 Tons	123	x	78.2	=	9618.6
6.	169 Tons	123	x	90.3	=	11106.9
7.	193 Tons	155	x	104.0	=	16120.0
8.	217 Tons	122	x	122.4	=	14932.8
9.	242 Tons	305	x	138.4	=	42212.0
10.	266 Tons	523	x	155.3	=	81221.9
11.	290 Tons	369	x	172.7	=	63726.3
12.	314 Tons	62	x	190.9	=	11835.8
13.	340 Tons	305	x	211.5	=	64507.5
14.	362 Tons	366	x	236.7	=	86632.2
15.	386 Tons	245	x	259.4	=	63553.0
16.	411 Tons	123	x	284.5	=	34993.5
17.	435 Tons	122	x	311.1	=	37954.2
18.	459 Tons	153	x	340.2	=	52050.6
19.	483 Tons	92	x	403.7	=	37140.4
20.	TOTAL LINES 1-19			(Enter on Line 21)	=	692603

B. ENERGY COST FOR CHILLER:

21. TOTAL (Line 20) 692603 x $\frac{460v \times 1.73 \times \$0.05}{1000}$ = $ 27558.7

NOTE: Enter Line 21 on Line 1 of Energy Cost Worksheet No. 1

ENERGY COST WORKSHEET NO. 3

COOLING TOWER ENERGY COST

A: COOLING TOWER ENERGY CONSUMPTION:
1. Fan Motor Amperes (Each) 1.21 x 2 x 4416 Hrs/Yr = 106867 (Enter on Line 2)

B. ENERGY COST FOR COOLING TOWERS:
2. (Line 1) 106867 x $\frac{460v \times 1.73 \times \$0.05}{1000}$ = $ 4252

NOTE: Enter Line 2 on Line 2 of Energy Cost Worksheet No. 1

ENERGY COST WORKSHEET NO. 4

PUMP ENERGY COST

A: CHILLED WATER PUMP ENERGY CONSUMPTION:
1. Pump Motor Amperes 69.6 x 4416 Hrs/Yr = 307354

B. CONDENSER WATER PUMP ENERGY CONSUMPTION:
2. Pump Motor Amperes 42.9 x 4416 Hrs/Yr = 189446
3. TOTAL LINES 1 and 2 TOTAL = 496800 (Enter on Line 4)
4. (Line 3) 496800 x $\frac{460v \times 1.73 \times \$0.05}{1000}$ = $ 19768

NOTE: Enter Line 4 on Line 3 of Energy Cost Worksheet No. 1

EQUIPMENT PROFILE WORKSHEET

FOR INSTRUCTIONS SEE SECTION 00101

A. CHILLER:
EVAPORATOR
1. Flow rate = 1160 GPM
2. Leaving water temperature = 44 deg. F.
3. Pressure Drop = * 11.4 Ft.
4. Fouling Factor = .0005
CONDENSER
5. Flow Rate = * 1450 GPM
6. Pressure Drop = * 16.1 Ft.
7. Fouling Factor = .001

B. COOLING TOWER:
8. Water Flow Rate = * 1450 GPM
9. Fan Motor Running Load Amperes (each) * 12.1 Amps

C. CHILLED WATER PUMPS:
10. Flow Rate = 1160 GPM
11. Total Head = 155 Ft. + Evap. Press. Drop (line 3.) * 11.4 = *166.4Ft.
12. Motor Running Load Amperes = * 69.6 Amps

D. CONDENSER WATER PUMPS:
13. Flow Rate = * 1450 GPM (LINE 5)
TOTAL HEAD:
14. Condenser Pressure Drop (line 6) = * 16 Ft.
15. Piping Pressure Drop = 65 x $\left(\frac{\text{flow rate (line 5)}}{1450}\right)^2$ = * 65 Ft.
16. Total Head (line 14 + line 15) * 81 Ft.
17. Motor Running Load Amperes = * 42.9 Amps.

NOTES: * Bidder's Option

LOAD PROFILE WORKSHEET

FOR INSTRUCTIONS SEE SECTION 00101

LOAD	AMBIENT WET BULB	CHILLED WATER SUPPLY - RETURN			CONDENSER WATER SUPPLY - RETURN			CHILLER AMPS
48 Tons	62 deg. F.	44 deg. F	- 45	deg. F.	* 63	deg. F.	- * 64	deg. F.	* 49.1
72 Tons	63 "	44 "	- 45.5	"	* 64.5	"	- * 66	"	* 46.4
97 Tons	64 "	44 "	- 46	"	* 65.9	"	- * 67.9	"	* 56.0
121 Tons	65 "	44 "	- 46.5	"	* 67.3	"	- * 69.8	"	* 65.2
145 Tons	66 "	44 "	- 47	"	* 68.7	"	- * 71.7	"	* 78.2
169 Tons	67 "	44 "	- 47.5	"	* 69.9	"	- * 73.4	"	* 90.3
193 Tons	68 "	44 "	- 48	"	* 71.2	"	- * 75.2	"	* 104.0
217 Tons	69 "	44 "	- 48.5	"	* 72.6	"	- * 77.1	"	* 122.4
242 Tons	70 "	44 "	- 49	"	* 73.9	"	- * 78.9	"	* 138.4
266 Tons	71 "	44 "	- 49.5	"	* 75.0	"	- * 80.5	"	* 155.3
290 Tons	72 "	44 "	- 50	"	* 76.3	"	- * 82.3	"	* 172.7
314 Tons	73 "	44 "	- 50.5	"	* 77.4	"	- * 83.9	"	* 190.9
340 Tons	74 "	44 "	- 51	"	* 78.5	"	- * 85.5	"	* 211.5
362 Tons	75 "	44 "	- 51.5	"	* 79.6	"	- * 87.1	"	* 236.7
386 Tons	76 "	44 "	- 52	"	* 80.8	"	- * 88.8	"	* 259.4
411 Tons	77 "	44 "	- 52.5	"	* 81.9	"	- * 90.4	"	* 286.5
435 Tons	78 "	44 "	- 53	"	* 82.9	"	- * 91.9	"	* 311.1
459 Tons	79 "	44 "	- 53.5	"	* 83.9	"	- * 93.4	"	* 340.2
483 Tons	81 "	44 "	- 54	"	* 85.8	"	- * 95.8	"	* 403.7

*Bidders Option
Note: Chiller amperes shall be the input amperes to the chiller starter or frequency converter device.

LIFE CYCLE COST WORKSHEET

FOR INSTRUCTIONS SEE SECTION 00101

1.	INITIAL COST $ 298,625.00 x 0.91	= $271,749
2.	1st YEAR OPERATION, MAINTENANCE & REPAIR COST $ 15,060 x 0.83	= $ 12,500
3.	2nd YEAR OPERATION, MAINTENANCE & REPAIR COST $ 22,308 x 0.75	= $ 16,731
4.	3rd YEAR OPERATION, MAINTENANCE & REPAIR COST $ 22,308 x 0.68	= $ 15,169
5.	4th YEAR OPERATION, MAINTENANCE & REPAIR COST $ 23,712 x 0.62	= $ 14,701
6.	ANNUAL ENERGY COST $ 51578.7 x 6.5	= $335,262
7.	TOTAL LIFE CYCLE COST (Line 1+2+3+4+5+6)	= $666,112

Figure 1

i. (.75) 2nd year's OM&R	16,731	16,356
j. (.68) 3rd year's OM&R	15,169	14,829
k. (.62) 4th year's OM&R	14,701	14,391
l. (6.5) yearly energy cost	335,262	435,838
m. LCC (total g.-l.)	$666,112	$742,498

As you can see from the comparison just made, bidding the project on a life-cycle basis resulted in a life-cycle savings to the government of $76,386 even though the first cost increased by $25,000. More than 10 percent of the conventional life-cycle cost was saved. The reactions from the contractors and equipment manufacturers have been favorable to the method.

Although only chilled water systems have been procured to date using the method, there are other applications. The following criteria should be applied to assure that the method is applicable:

- The facility or equipment being procured has considerable energy and/or operations, maintenance and repair costs when compared to the first cost.
- There is a measurable way to bid and verify the future costs.
- The facility or equipment to be procured can be packaged so that it is a major part of the work, not a relatively small part of a major project.
- The present government work force will not be adversely affected (downgraded or displaced) by a contractor performing the operation, maintenance and repair of the facility or equipment. □

Avoiding the pitfalls of construction contracts

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THE COST OF CONSTRUCTION is estimated and bid by the contractor to meet the anticipated construction schedule and make a profit. The bid reflects the contractor's historical productivity rates, taking into account *normal* construction delays. If the government causes an abnormal delay or impact, the contractor will be entitled to "equitable adjustment" of the contract amount. The contractor will be compensated for government-caused changes or abnormal delays and impacts over which he has no control.

The burden of initiating a request for time or money is on the contractor. Many times, the paperwork burden appears to exceed the value of the minor changes. The cumulative effect of absorbed changes may be schedule impacts and ripple costs in excess of historical productivity rates on which the contractor had based its original cost estimate. For the sake of the government's interest in the contractor's ability to perform to completion, as well as for its own profitability and continued operation, the contractor has a duty to document the changes and the reasons for changes, as well as the costs attributable to those changes.

Requirements for equitable adjustment

Because it is usually never known at the first moment whether an apparently small change will result in an abnormal delay or impact, the contractor's first project management goal is to document every change. This documentation may be required later to establish to the satisfaction of the government (or the private sector owner) that delays to the schedule caused by changes beyond the contractor's control have impacted costs.

Cost savings as well as additional costs must be monitored by both parties. Since equitable adjustment of the contract amount may be additive or deductive, obviously the contracting officer has a duty on behalf of the taxpayer to fully document changes to protect the government's position. This means making contemporaneous records including photographs. It also means daily review of contractor daily reports, and supplementing or taking exception to contractor reports at the time, in case of disagreement or omission. Under the design contract, the resident officer in charge of construction (ROICC) may ask the architect-engineer (A-E) to review contractor submittals including cost estimates, methods, or materials proposed in response to requests for proposal (RFPs). Care should be taken not to exceed the government's contractual time for review, giving rise to a construction contractor claim for delay.

If priority review is required, the contractor must notify the ROICC that approval of the submittal is time-critical. This should be indicated on the contractor's schedule. Otherwise, no claim can be made for government-caused delay, since review time permitted under the contract cannot be defined as "delay."

When directed by a field change request, the contractor must initiate requested changes in the work and within 15 days submit estimates of costs to accomplish the change. *Cost to the contractor of accomplishing the change, and not value to the government, is the test of cost reasonableness.*

The government will prepare its own independent estimate of the cost for every proposed contract modification, including all change orders, prior to negotiation (NAVFAC P-68, *Contracting Manual*, Ch. 87-02, para. 43.114(a)).

The contractor's difficulty is in estimating *effects* of changes. A detailed estimate of labor, material, and equipment multiplied by their respective costs will be insufficient to fully compensate for changes, although it is certainly a starting point.

The contractor must establish both entitlement to and quantum of equitable adjustments. In addition to direct and indirect costs, impact or ripple effects will be estimated and incorporated into the construction schedule.

On most military construction (MILCON) jobs, a computer-generated network analysis schedule will be available to determine the critical path and compute time for the entire job, reflecting both original work and impact of changes. The contracting officer is the person who has to be convinced–it is on his recommendation or approval that payment for impact costs will be made. The breakdown of costs must be satisfactory to the contracting officer (Department of Defense Federal Acquisition Regulation Supplement (DFARS) 52.236-7001). The integrity and honesty of both parties is on the line as government and contractor "bargain in good faith" to see that neither party is injured by the other's actions. Equitable adjustment assures both parties, not just the "big guy," a means of remaining or being made whole.

For example: A design change is made due to unforeseen site conditions that require a retaining wall and drainage system.

Direct costs include labor used in excavation, construction, and erection of falsework, and procurement of steel and concrete. Some of the forms and timber used in the falsework for this wall were previously used on a freeway job; it is expected that most of the lumber and some of the forms will be salvageable for use on a third job. The cost of the falsework construction materials used in two or more jobs is an indirect cost. Labor used to build the falsework and later to dismantle the temporary structure is a direct cost to this job. Cartage may be a direct cost of this job; storage at the contractor's yard until it is used again is neither an indirect nor direct cost of this job, but part of the contractor's overall cost of doing business, reflected in his overhead rate.

The impact of the change would include costs of the new steel and additional concrete, the carpenters and operators, equipment rented for the particular purpose and not used elsewhere on the job, plus time or "delay costs" while the footings were excavated and the new wall erected, plus the direct and indirect costs of the falsework and the new wall. The ripple might be measured in increased labor rates for downstream tasks, caused by the delay, and increased prices in materials due to price escalation. Ripple might be seen in the delays of other parts of the work, with additive or--rarely--deductive changes in time or costs required for performance. Overtime used by laborers in the later stages of construction may be attributable to delay during a phase in the early stages. A delay in excavation and structural steel erection may reflect in higher wages or overtime being paid the finish painters touching up the captain's quarters on the last day of the project.

There are risks in estimating ripple up front as opposed to after the fact, since the cost of impacts is frequently many times the direct cost of the change. Recognizing this, the contractor may submit a claim for the direct cost of complying with a change, reserving the right to later pursue a claim for the indirect cost impact on the project as a whole.

It is possible to inflate the impacts and ripple by overestimating time required to accomplish changed work, failing to overlap concurrent tasks, or by having originally constructed a critical path diagram with too little float. For this reason, it is essential that the ROICC/contract administrator understand the varying effects of the choice of methodology, as well as of application, of the contractor-prepared network analysis system.

Although the use of schedules for construction contracts was optional under 52.236-15, Schedules for Construction Contracts (April 1984), their use has been "mandatory where the best interest of the government would be served" by their use (WESTDIV ROICC Manual, Chap. 4.0, p. 19).

It is the policy of NAVFAC to encourage use of network analysis systems (WESTDIV ROICC Manual, Chap. 4.0, p. 19).

The new (1988 edition) DFARS 252.236-7012 *directs* use of the Contractor-Prepared Network Analysis System clause. This clause details one type of network system methodology. Other acceptable network system methodologies and types are listed in Appendix I of the U.S. Army Corps of Engineers' Regulation ER-1-1-11, entitled "Network Analysis System." Single copies of ER-1-1-11 are available from the OCE Publication Department, 2803 52nd Avenue, Hyattsville, Md. 20781-1102.

DEFINITIONS

Direct costs "can be identified with a particular final cost objective" (FAR 31.202); indirect costs are those "identified with two or more final cost objectives or an intermediate cost objective" (FAR 31.203). Indirect costs are those costs which cannot be directly attributable to one item of work such as field office or superintendent, and must be time sensitive--not one-time costs.

Disruption of the contractor's project schedule may cause "ripple effects." Ripple effects are quantifiable direct secondary changes proximately caused by the impact of the primary change. Impacts may be primary or secondary; costs may be direct or indirect. Ripple is a secondary impact which may affect both direct and indirect costs. The burden of proof is upon the contractor to demonstrate entitlement as well as quantum. Direct and indirect costs plus consequential damages directly flowing from the changes may result in an "impact claim" if equitable adjustment of the contract terms has not compensated the contractor for these secondary effects.

If the contracting officer intends to deny the request for equitable adjustment, the contractor must be advised in writing of the proposed denial and the claim forwarded within 15 calendar days for final determination of the contracting officer (WESTDIV ROICC Manual Chap. 4.0, p. 47).

FAR Part 52 required that *within 15 days* after receipt of the notice of award, the construction contractor is required to submit to the government for approval a "practicable construction schedule." The construction schedule was required under DFARS 52.236-7002(c)1.3.3.2 to be updated at monthly intervals "or as directed." This provision is still in effect for most NAVFAC construction contracts now in execution.

The new clause of DFARS 252.236-11(c)(1) requires submission of a preliminary network defining the contractor's first 60 calendar day activities *within 10 days* after notice to proceed.

Where section 01013 is included in the contract, timeframes therein would supersede FAR timeframes.

A network analysis system consists of diagrams, supporting mathematical analyses showing the order and interdependence of activities, and sequencing. Government activities affecting progress and contractual dates are also shown. The mathematical analysis not only shows start/finish dates but slack or float, and the monetary value of the activity. Changes occurring since the last update are incorporated. With each invoice for progress payment, the construction schedule and equipment delivery schedules are required to be revised and updated. The new DFARS 252.236-7012(e) states the contractor shall report actual construction progress by updating the mathematical analyses at intervals of 15 calendar days. (Check your contract

for its requirements.)

Once the job is underway, contracting aspects present as many hazards to profitability for the contractor, and overrun to the government, as does the actual physical activity of construction.

If the government directs an in-scope change, under the Changes clause (FAR 52.243-04), the contractor is obligated to perform as directed. If the contractor fails to perform the in-scope change, he can be defaulted for breach of contract, even after all other work has been completed satisfactorily.

Default is a disastrous alternative to performance, since the contractor can then be held liable to pay the government for costs of reprocurement and almost certainly higher costs to complete by a completing contractor. The bonding company will be extremely unhappy; it is doubtful that the contractor will be allowed to bid the same volume of work in the near future. Without adequate bonding capacity, the contractor is out of business for government projects requiring a bond.

A change order is a means of ordering variations, changes, and additions to work already under contract. It is issued on a Standard Form (SF) 30. If necessary to direct changes by a unilateral modification, specific approval must be obtained.

Once the job is underway, contracting aspects present as many hazards to profitability for the contractor, and overrun to the government, as does the actual physical activity of construction.

Since 1943, the courts have held that performance of work without a written change order gives rise to an "implied contract to pay" when the government receives the benefit of the work and the change was performed at the oral direction of a responsible officer. *Armstrong & Co. v. United States*, 98 Ct. Cl. 519 (1943).

The risk of choosing to go ahead on a written or oral notice to proceed (NTP) or informal written authorization to proceed (ATP) is obviously less risky than refusing. NAVFAC P-68, Ch. 87-02, para. 43.207 directs that Part I modifications be sparingly used; informal ATPs are not allowed.

It may be news to some but, in ordinary circumstances, formal contract modifications describing changes in the work and contract price and time are required to be executed before the contractor is permitted to proceed. It must be emphasized that use of the SF-30 change order is extraordinary, and should not be continually employed; especially where time permits, solicitation of the contractor's breakdown, and negotiation of an equitable additive or deductive amount should always be done.

In the heat of construction, negotiations may not be perceived to be the most urgent order of business for the contractor, who will be busy keeping on schedule, "putting out fires," initiating requests for information (RFIs) to clarify specifications or drawings that did not appear questionable until the field work tested the paperwork. He will have to manage the scheduling and coordination of trades, last-minute adjustments to prevent overmanning, preparation of revised drawings and as-builts, adjustments to delivery schedules necessitated by supplier variances, and shifting or selecting competent field supervision to assure quality control.

Coordination of changes is a pain that never goes away although it may be mitigated by good planning and a good system rigorously followed. In the bustle of reality, bilateral negotiation of the changes may get pushed back.

Sometimes we forget that owner, designer, and constructor are members of the same team. Folks on the government team sometimes challenge the motives of the A-E or construction contractor, and vice versa. One such mistaken view holds that the contractor, if cash flow or corporate prosperity permits, will refuse to negotiate the impact costs of changes until the end of the job. The theory is that only then will the cumulative effects of small changes and brief delays be visible or costs capable of being validated.

On the other hand, cynics in the general contracting business complain that the contracting officer squeezes them by issuing "no cost" changes, refusing to negotiate time extensions for changed or additional work, and denying claims for impact and ripple effects.

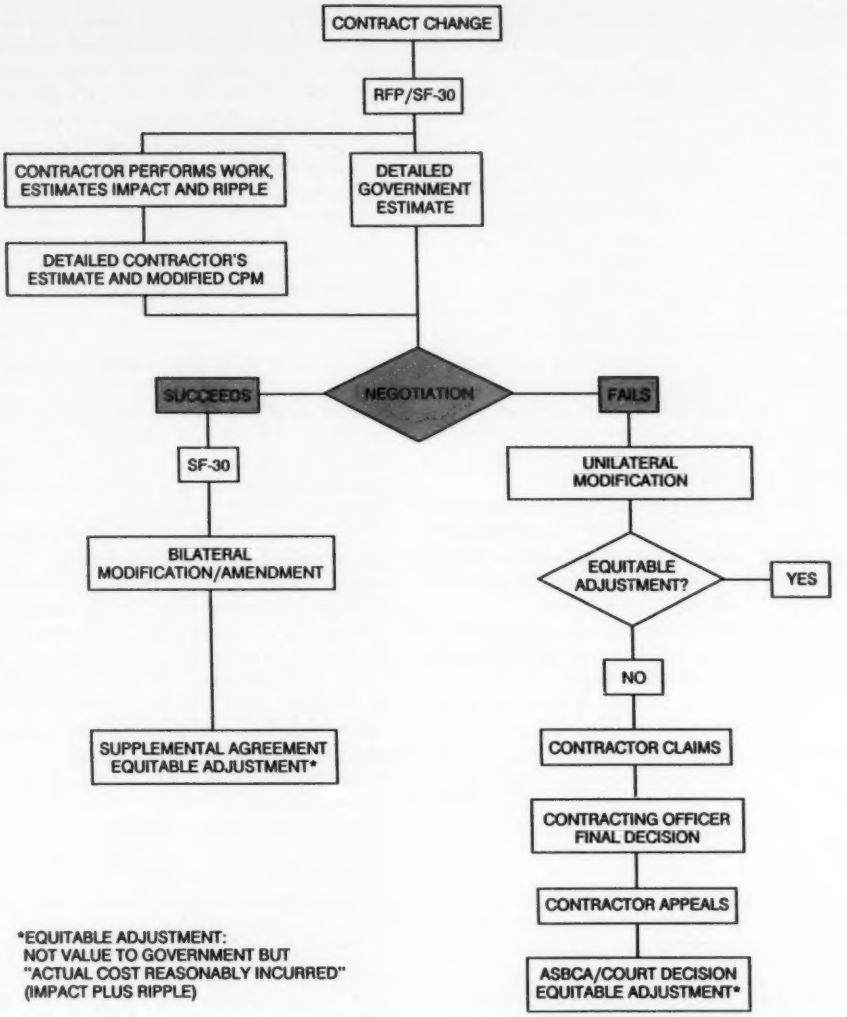
Occasionally, a contractor does overreach, and occasionally a contracting officer does deny compensation to which the contractor is equitably entitled. Refusing time when time extension *must* be considered denies the contractor the contractual right to equitable adjustment, as set out in the Changes, Differing Site Conditions, Suspension of Work, Value Engineering, and Time Extension clauses (among others). This may create a basis for tort recovery against the erring contracting officer. Torts are civil wrongs for which the law provides a remedy. Tort actions arising out of acts causing physical or psychological injury, harm to the reputation, economic harm, or intentional interference with a protected constitutional interest, may be brought. Federal officials have immunity from suit only if they have acted within the proper scope of agency. FAR 43.102 and NAVFAC P-68 (October 1988) 43.112 give contracting officers the authority to order in-scope changes.

It appears that knowingly exceeding the scope of one's authority, exceeding bounds of ministerial discretion (for example, by willfully and maliciously refusing to negotiate time under clauses which expressly provide for time to be negotiated as part of the equitable adjustment) might make a contracting officer personally liable for damages. No one would want to find out the hard way.

Contractors should not be asked to give away their legal right to compensation for the true costs of accommodating government requests, making changes required by differing site conditions, responding to revisions in plans and specifications by the A-E, or because of a supplier's or manufacturer's recommendation. The contract normally specifies how float is to be treated.

Some field changes will be initiated at the request of the contractor because the three-dimensional jobsite reality or past experience shows the design concept that looked okay on paper simply won't work.

Whatever the reason for changes, it is true that every change (impact) has some effect (ripple) on every downstream aspect of the system. While construction contracts contemplate this dynamic process of change, adjustment,



late and early supply deliveries, trade unrest or strikes, weather, and unforeseen site conditions, neither contractor nor government/owner is benefitted when one party is disadvantaged to the eventual harm of both.

What then is fair? "Equitable adjustments are simply corrective measures utilized to keep a contractor whole when the government modifies a contract. Since the purpose underlying such adjustments is to safeguard the contractor against increased costs engendered by the modification, it appears patent that the measure of damages cannot be the value received by the government." *Appeal of Jacobson Construction Co.*, VABCA No. 1811 (Aug. 21, 1984); CCM November 1984, p. 6.

The contractor should not be expected to absorb all the risks of change, especially since the government's policy is to request competitive bids as low as possible, for which it guarantees in the contract clause that changes affecting the agreed-upon schedule will be compensated.

The government owner expects to take risk, as defined in the contract. Within the private sector, more flexibility exists. Private sector owners may contract with whomever they choose. If there is a little more slack in the budget, the owner may expect the contractor to absorb the costs of small changes. The contractor working for the government cannot afford to absorb the changes; every penny has already been counted.

The question is, *how should the contractor respond*? He may be well advised, if he can afford to wait, not to sign any modifications. This will force the government to issue unilateral modifications, which are subject to equitable adjustment.

Under the Changes clause, an in-scope change can be issued without the requirement of consent of the contractor and without new consideration. It is binding on the contractor and surety by their agreement to the terms of the original contract. Major change orders reflect four main causes: (1) changes ordered by the government, including design-coded changes arising out of changes in design criteria or the discovery of errors found during shop drawing review or responding to change requests by the ultimate

user/customer; (2) changes arising out of differing site conditions; (3) time extensions; and (4) termination for default--damages for delay, in the extreme case.

As long as the change is not a cardinal change, the contractor must carry out the change promptly; the government has the duty to pay. (A cardinal change is one that is directed outside or beyond the scope of the original contract.) Unilateral demand for a cardinal change in scope would not result in contract modification, but in breach of the contract by the government. The contractor is under no obligation to perform the out-of-scope change--but if he makes a mistake in adjudging a requested change not to be in scope, and it later turns out upon review by the Armed Services Board of Contract Appeals (ASBCA) or the courts that the contractor was wrong, he will be defaulted for having refused to perform the changed portion of the work.

Once the contractor signs the SF-30 without reservation of rights to negotiate impacts and ripple at a later date, his signature effectuates "bilateral negotiation" of "equitable adjustment of the change."

On the government's side, the contracting officer must keep in mind that pricing changed work based upon what he or she estimates as the *value to the government* is contrary to the concept of equitable adjustment. Instead, the adjusted price must reflect *the contractor's actual costs.*

The "Bruce Case" rule of equitable adjustment sets a standard of actual costs, reasonably incurred, as the basis for proper determination of an adjustment.

The dire consequences of a mistake make it highly unlikely that the contractor will take the risk of refusing to perform changed work. Rather, he will advise the government contracting officer that the requested change is out of scope, perform it, and later take it to court. If he prevails, he wins damages for breach as well as compensation for the work performed, plus interest for amounts due from the date originally payable.

The basic construction contract expressly sets forth the rights and obligations of the parties with regard to configuration, delivery, and payment for a completed facility. If, after the basic contract comes into existence, any change is required of the contractor, it will be accomplished by contract modification. It is desirable that the modification represent a bilateral agreement as to its terms, the change to be performed, and the full amount the government is going to pay for the change.

Especially in major works, the wise contractor insists upon negotiating costs of impacts and ripple under the equitable adjustment principle. The contracting officer may not concur that changes have caused or will cause additional costs to the contractor not contemplated under the original terms and conditions of the award. Adjusted critical path method (CPM) schedules and cost analyses may demonstrate the contractor's point.

In many cases, the contracting officer simply issues a unilateral modification when the contractor resists or negotiation founders. Pressure is applied by using a low "reasonable government estimate" for the unilateral contract modification award amount, and hoping the contractor will not find it cost-effective in terms of time, legal and accounting costs, or hassle, to contest the "reasonable" amount later.

Since the contractor and his surety are bound by the original contract and the contractor must continue performance or be subject to default termination, he may decide the best option is simply not to sign the SF-30, thereby declining to enter into a bilateral agreement.

In the construction industry, people should never forget the legal distinction between mutual or bilateral agreements, which are *supplemental*, and unilateral modifications (decisions by the government alone as to what it will pay for changes), which are always subject to the contractor's legally enforceable right to an equitable adjustment. FAR 43.101 defines any contract modification accomplished by the mutual action of the parties as a "supplemental agreement."

Using in-scope changes/'change orders'

It is an old habit in the construction industry to refer to in-scope changes as "change orders." Written orders signed by the contracting officer, directing changes under the Changes clause are unilateral contract modifications until signed by the contractor.

The contractor may preserve his right to equitable adjustment of the contract by refusing to sign the SF-30, or by adding a disclaimer reserving his rights if he does sign.

Regardless of whether the contractor calls it a claim, or proposal for impact costs, an equitable adjustment, or request for interpretation of contract terms, the Disputes clause and P-68 para. 7-401 state that *any written demand by a contractor for money and or time under the contract is a claim*, even if the amount of money or time requested is not stated by the contractor. Although the government through the contracting officer may continue to assert its position as to time and dollars due to or from the contractor, if no bilateral agreement is reached, the contracting officer must eventually issue a written "final decision." The contractor can appeal the decision under the Disputes clause. A claim for equitable adjustment must be asserted by the contractor before final payment.

The parties still have the opportunity to reach a bilateral agreement any time before a final ASBCA or court decision. When fully executed, the equitable adjustment agreement extinguishes the claims of both parties unless fraud or other unusual circumstances are present.

The change order may be the most important vehicle for controlling impact costs. If reasonable adjustments to *time as well as* dollars are made at the time the unilateral modification is issued, the contractor will have fewer grounds in law or equity on which to later contest entitlement or quantum.

First, he will have had the use of the money, and the extension of time (avoiding possible liquidated damages clauses or costs of delay).

Second, he will have a less valid argument about the failure of government estimates to take account of real costs of construction "imponderables."

Predictable expenses such as increased bond or insurance premiums can be calculated as part of the government estimate on which the engineering field division (EFD)/ officer in charge of construction (OICC) or field-initiated modifications can be issued.

If he needs it, the ROICC or contracting officer should request technical analysis of contractor proposals from the

EFD or the A-E. In accordance with the provisions for "Equitable Adjustments: Waiver and Release of Claims," NFGS 01010, para. 1.11, the contractor's proposal must include total amounts for all types of adjustments including those arising out of delays or disruptions. The government should not rely upon the contractor, nor should it automatically disbelieve the contractor. To quote former President Ronald Reagan, "Trust but verify."

Caution must be exercised. Even though the contractor in good faith may have certified the cost or pricing data, there may be a mutual mistake in assumptions. For example, it may be erroneously presumed that whether impacts upon the construction schedule are computed prospectively or retrospectively, the same answer will result.

Both the Changes and Differing Site Conditions clauses of the construction contract give the contractor the right of equitable adjustment for direct and indirect costs directly or indirectly increased or decreased by performance of any part of the work *changed* by change order.

Impact costs are mostly a matter of judgment; only escalation of material prices, labor wage rates, and construction equipment rental rates can be considered wholly "objective" or "factual." Increased costs due to extended storage of materials and equipment, subsistence payments for crew, longer employment of support or overhead staff and home office or field office materials, utilities, equipment, as well as possibly longer periods of support equipment rentals (computers, typewriters, copiers), are partially "objective" and partially subjective. What proportion of the home office copier base rental should be applied if only 10 copies of job-related paperwork were made in the last month of the job?

Not all contractors are large or sophisticated enough to know actual costs even though they keep daily records. Sometimes, it is a case of waking up one day after months of complying with change requests and realizing the impact upon the scheduled completion date and the bottom line of their willingness to "be a good guy." At that point, realization of impact of the individually insignificant cumulatively significant costs, forces them to request an equitable adjustn ent in price and time. If they have signed each SF-30 as a bilateral modification, this opportunity is theoretically lost. Construction contractors spread the word among themselves about such costly mistakes. The contracting officer is not likely to get contractors' signatures on each modification, given the risk to contractors of losing money by premature bilateral agreement.

The overwhelming majority of the ripple or impact calculation is a matter of discretion and judgment. If the contractor has a convincing argument, the OICC/ROICC contracting officer is likely to listen. Inefficiencies due to loss of original crew may lead to high costs from a new learning curve, or overtime. Job rhythm is affected. Rescheduling leads to inefficient use of manpower. Some employees sit idle because their expertise cannot be applied to interim tasks. Morale is affected and a general work slowdown may be alleged to be directly attributable to the small change initiated at the beginning of the job. Salesmanship and credibility become valuable assets of the contractor in negotiating ripple or impact costs.

Contractors sometimes submit claims alleging impact cost assertions based upon receipt of high numbers of

40 complete CEC basic training

Forty members of basic class no. 187 graduated on March 10, 1989, from the Naval School, Civil Engineer Corps Officers, Port Hueneme, Calif. The class completed eight weeks of specialized training in the Navy's needs for shore installation engineering, public works management, construction contracting and administration, and Seabee operations.

Six graduates finished with honors, four with distinction. Lt. Scott Hayward and Ens. Carolyn Eibeck were the outstanding graduates of the class. Their photographs are indicated by an (*). Those students graduating with distinction are indicated by a (•); those entering Seabee duty are indicated by a (†).

* **Ens. Carolyn Eibeck**
BARCH/Auburn Univ.
to NAVFAC, NS Adak, Alaska

* **Lt. Scott Hayward**
BSME/Univ. of Rochester
to SOUTHDIV Cont. Off., Jacksonville, Fla.

Lt. j.g. Louis Beldao**
BSEE/Purdue Univ.
to CHESDIV Cont. Off., MCB Quantico, Va.

Ens. Russell Bruner
MSEE/Vanderbilt Univ.
to NORTHDIV Cont. Off., Brunswick, Maine

Lt. j.g. Timothy Benedde
BSSE/Univ. of Fla.
to SOUTHDIV Cont. Off., NTC Orlando, Fla.

Lt. Spiro Colella
BEEE/Pratt Inst.
to WESTDIV Cont. Off., MCB Camp Pendleton, Calif.

Ens. Paul Cook
BSME/Texas Tech.
to WESTDIV Cont. Off., NAS Whidbey Island, Wash.

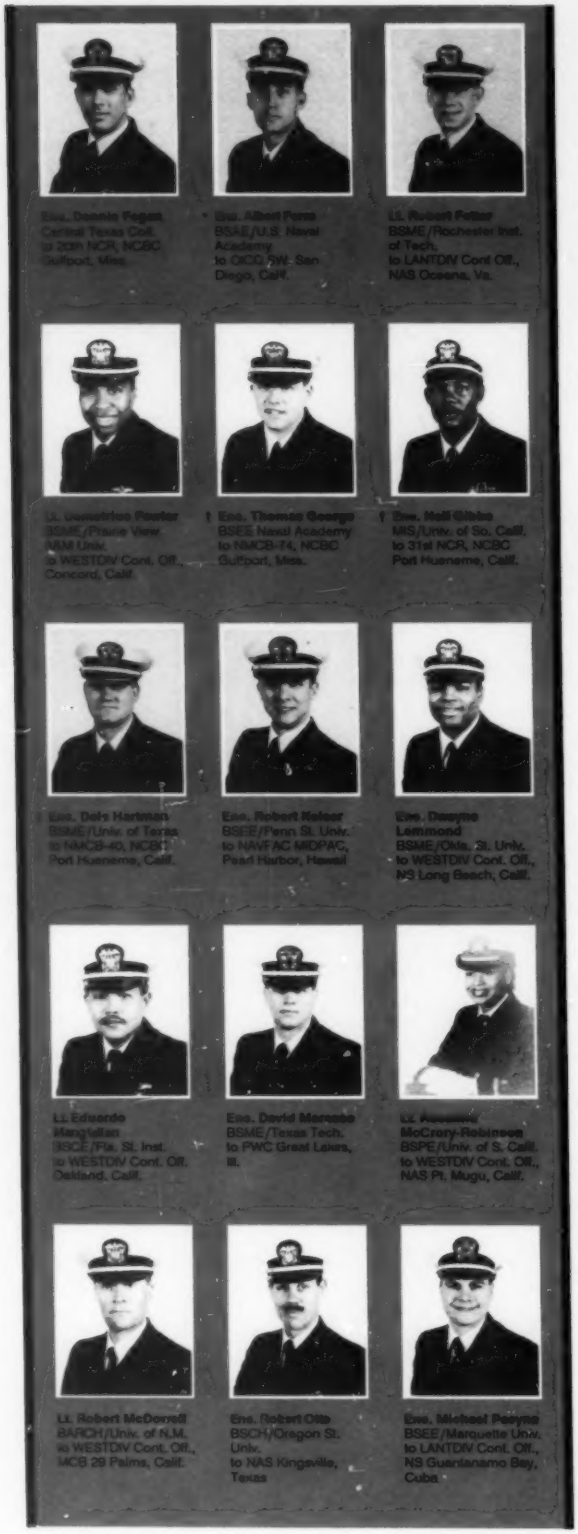
Lt. James Cummings
BME/Villanova Univ.
to NS Mayport, Fla.

* **Ens. John D'Angelo**
BSAAE/Purdue Univ.
to NORTHDIV Cont. Off., PWC Great Lakes, Ill.

Ens. Kurt Dante
BSME/Univ. of N.H.
to NAS Miramar, Calif.

Ens. Paul Demoncada Jr.
BARCH/N.J. S. Arch.
to WESTDIV Cont. Off., Walnut Creek

Ens. Michael Falcone
BSCH/Tufts Univ.
to OICC SWPAC Cont. Off., Clark AB, R.P.



change orders. The number of changes alone will not support such a contention. The way in which changes affected unchanged work defines the extent of impacts. Only added costs (secondary or indirect cost of the ordered change) not originally within the contemplation of the parties become the basis of claim. The quantum will be the sum of impact plus ripple plus interest under the Prompt Payments Act, if applicable. (If monies to perform the change were borrowed and separately held and accounted for, not comingled with the balance of the job, a new decision awards direct interest as an equitable entitlement. See *Gevyn Construction Corp. v. United States*, 827 F.2d 752 (Fed. Cir. 1987); CCM December 1987, p. 4.)

Analysis of the theory of the underlying claim is as important as analysis of the method by which ripple is "proved."

Critical path method schedule

If the critical path method (CPM) schedule is followed, both parties will want to rely upon the agreed upon CPM schedule logic diagram, because it *appears* to be objective. To lawyers, engineers, and accountants particularly, figures and diagrams are comforting. They look to the quantifiable as being reliable. But one must remember that every segment in the original CPM schedule, every node of every activity, and consequently the critical path itself, was the result of judgment, not pure fact.

Assume Activity C is structural steel installation, on a fast-tracked major construction job. Is it reasonable, when design of subsequent stages and phases is proceeding apace, cuts from suppliers/manufacturers have not all been received, and site conditions affecting design are still being discovered, that a firm cutoff date for this activity be such that predictable delays will impact it? The effects of ripple beginning so early are bound to impact every follow-on activity. Will the consequent "equitable adjustment" of price and time be fair?

Consider also whether negotiating prospective ripple will yield the same time and dollar results as negotiation after the fact. In one recent case, ripple was computed by starting with the original CPM schedule, adding time from every change order issued in the first month, revising the CPM to incorporate slippages, adding time from change orders issued in the second month, inputting actual start/finish dates and percent completes for activities, revising the CPM, adding . . ., etc. The cumulative effect of changes upon a retrospectively changed CPM schedule will probably be very different from those calculated to include future costs and secondary effects.

It may not be an incorrect procedure, but chopping up the entire job into month-long segments may lead to erroneous assumptions. Taking fragments of the network (frag nets) or month-long segments may magnify effects of every change and permit no change to become part of the historical ordinary course of construction. The quantum of additive or deductive changes upon CPM schedule segments or frag nets, may magnify the ripple effects. Use of frag nets instead of the entire CPM schedule may also have an effect of eliminating "float."

Construction is nothing but field adjustment of concepts to reality. Some changes will affect only non-critical path

activities. The effect of some impacts will be dissipated, not propagated. The question after the fact is whether the delayed activity or any of the ripples ended up actually being or affecting critical path items or activities.

All mathematical formulas and algebraic equations are merely agreed conceptual protocols by which the physical world of reality is represented. They do not exist in themselves, but as analogs of physical truths.

When the CPM schedule for an entire job is segmented and impacts allocated to each frag net, the representation can become untrustworthy. It may no longer approximate reality.

The paradigm of "impact" and "ripple" is taken directly from nature. If a pebble is dropped into a pond, its impact depends upon the force with which it strikes, which is dependent upon its mass and speed. The ripple may be imagined in the mind's eye. A large stone skipped across the water may strike several times before settling and sinking. A variety of secondary but proximately caused effects may be generated. The ripple and the impact will be mitigated by the size of the pond into which the "fact" has been dropped. The physical analog of "impact" and "ripple" clearly show the difficulty of accurately adducing ripple, even with the use of CPM schedules and computer-assisted calculations.

All mathematical formulas and algebraic equations are merely agreed conceptual protocols by which the physical world of reality is represented. They do not exist in themselves, but as analogs of physical truths.

It appears that use of an unknowingly flawed methodology (not known to the parties to give an erroneous result at the time of negotiation) would be a mutual mistake of fact. This should meet the definition of a "highly unusual circumstance" in which the fully executed bilateral agreement does not extinguish the claims of both parties. Either upon audit, for amounts in excess of $500,000, or upon the government's own motion, construction contract supplemental agreements or claims settlements in which a wrong methodology or application has produced unreasonable total costs, the agreement should be set aside (voided).

The basic principle of government contracting is to pay all reasonable, allocable, and allowable costs of services and materials plus reasonable profit.

For both construction contractors and the government, calculating reasonable, allocable, and allowable costs of impact and ripple is one of the pitfalls of contracting.

FOR CONCEPT REVIEW AND ENCOURAGEMENT, the author is indebted to Donald F. McDonald, Jr., vice president of Construction Performance Specialists, Inc., in Tyler, Texas. Mr. McDonald, a graduate engineer, is certified by the American Association of Cost Engineers as a Certified Cost Consultant.

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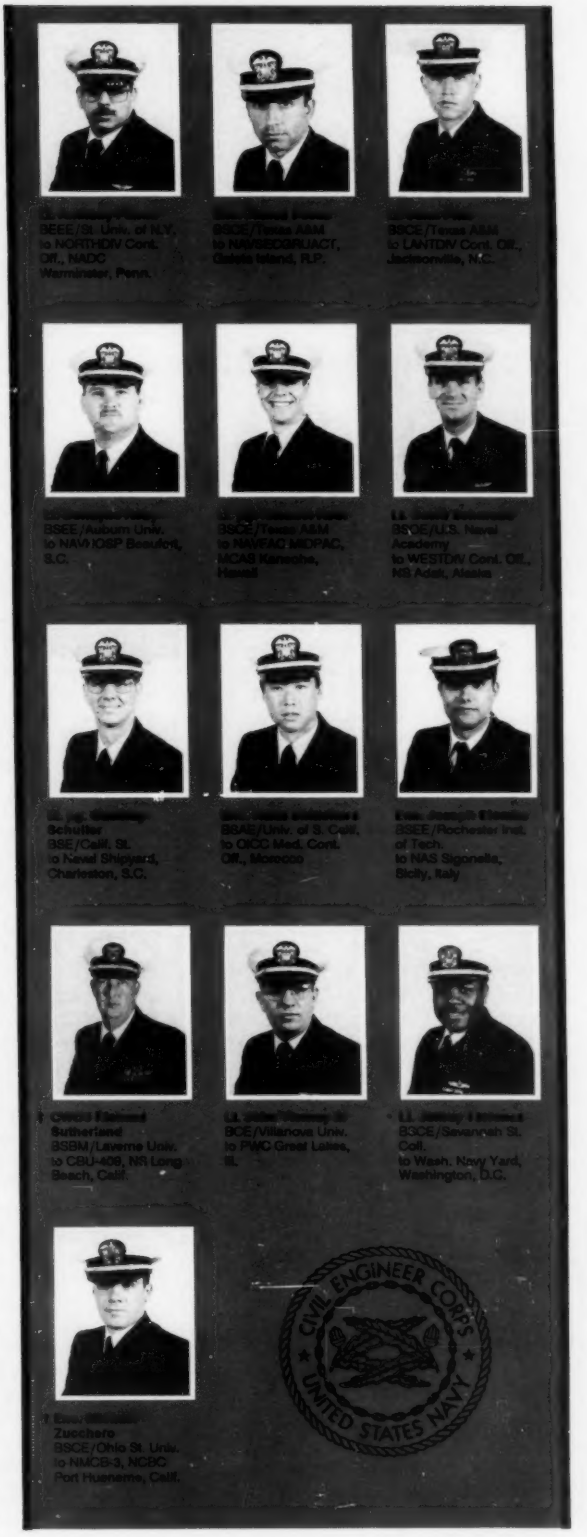

INSTRUCTOR IN THE SPOTLIGHT

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Specialty: Construction Contracts

The Naval Facilities Contracts Training Center in Port Hueneme, Calif., honors two of their outstanding instructors.

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Specialty: Facilities Support Contracting

Bonnie Harvey is the Construction Department Director at the NFCTC. She also teaches in our two-week Advanced Contract Management course. She is responsible for a full range of topics in the pre-award/post-award area of this course, including data rights, small business issues, financial and funding constraints, construction architects-engineers, and service responsibilities. Bonnie also provides support and guidance to the Construction Contract Modification course, advising on course management issues and constructive changes to the course.

Bonnie has been a member of NFCTC since March 1987, arriving from NAVFAC's Western Division in San Bruno, where she was Head of the Construction Contract Division. Her duties involved senior-level management decision making and contract management of several million dollars of projects. Prior to that, Bonnie had served as a contracting specialist, contracting officer, and ultimately Department Director in the Construction Department of the Tracey Defense Depot. Bonnie also has experience as a mechanical draftsman for a mechanical engineering firm.

Her 20+ years of federal service have prepared her well for her teaching position within NFCTC. Coupled with her excellent communication skills, this enables Bonnie to effectively transmit the most current DoD contracting issues to NAVFAC professionals.

On sunny southern California days, Bonnie spends some of her free time sailing near the Channel Islands.

The Naval Facilities Contracts Training Center (NFCTC), Port Hueneme, Calif., provides specialized training in construction, design, and facility support contracting administration to Naval Facilities Engineering Command (NAVFAC) civilian procurement personnel and Civil Engineer Corps (CEC) officers. This training is provided to enhance the professional knowledge and capabilities of our procurement personnel to meet the challenges of managing a contract workload which is growing in volume and complexity, satisfy Department of Defense (DoD)-mandated acquisition training requirements, and to support NAVFAC contracting officer warranting requirements.

In addition, NFCTC maintains the NAVFAC procurement training data base which records the completion of all acquisition-related training to track the progress of training within NAVFAC; is used in the development of individual training plans, forecasts future training needs, and verifies qualifications of procurement personnel and contracting officers.

By JOHN E. VERARDO, JR.
Academic Director
Naval Facilities Contracts Training Center
Port Hueneme, Calif.

Barbara McCoy is the Facilities Support Department Director at NFCTC. She oversees the instruction provided by the Facilities Support Contracting (FSC) courses. This responsibility ensures that NAVFAC students are getting the most current information in the FSC area. Barbara is also the primary instructor in the FSC II pilot courses currently under development. This next generation of training program illustrates the NAVFAC professional's desire to continue to enhance their contracting management skills.

Barbara has been with NFCTC since it opened in October 1985. Since that time she has prepared hundreds of NAVFAC employees for their careers in facilities acquisition. She became an instructor, and rose to the position of department director in April 1986. Prior to joining NFCTC she was a primary instructor at the Naval School, CEC Officers in their FSC course. As background to these teaching positions, Barbara served at Great Lakes as Director of the FSC Department and with the Veterans Administration as a contracting officer and purchasing agent. Her 15 years of federal service serve as fine background knowledge for her course directorship duties.

Barbara also manages a unique NFCTC/Air Force Institute of Technical (AFIT) Contract Law program, coordinating the course material and ensuring that the program is properly conducted by the NAVFAC attorneys who serve as instructors.

Barbara enjoys fresh-lake fishing, singing in a choir, and needlecrafts.

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